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BY JAMES J. HAGGERTY, JR.

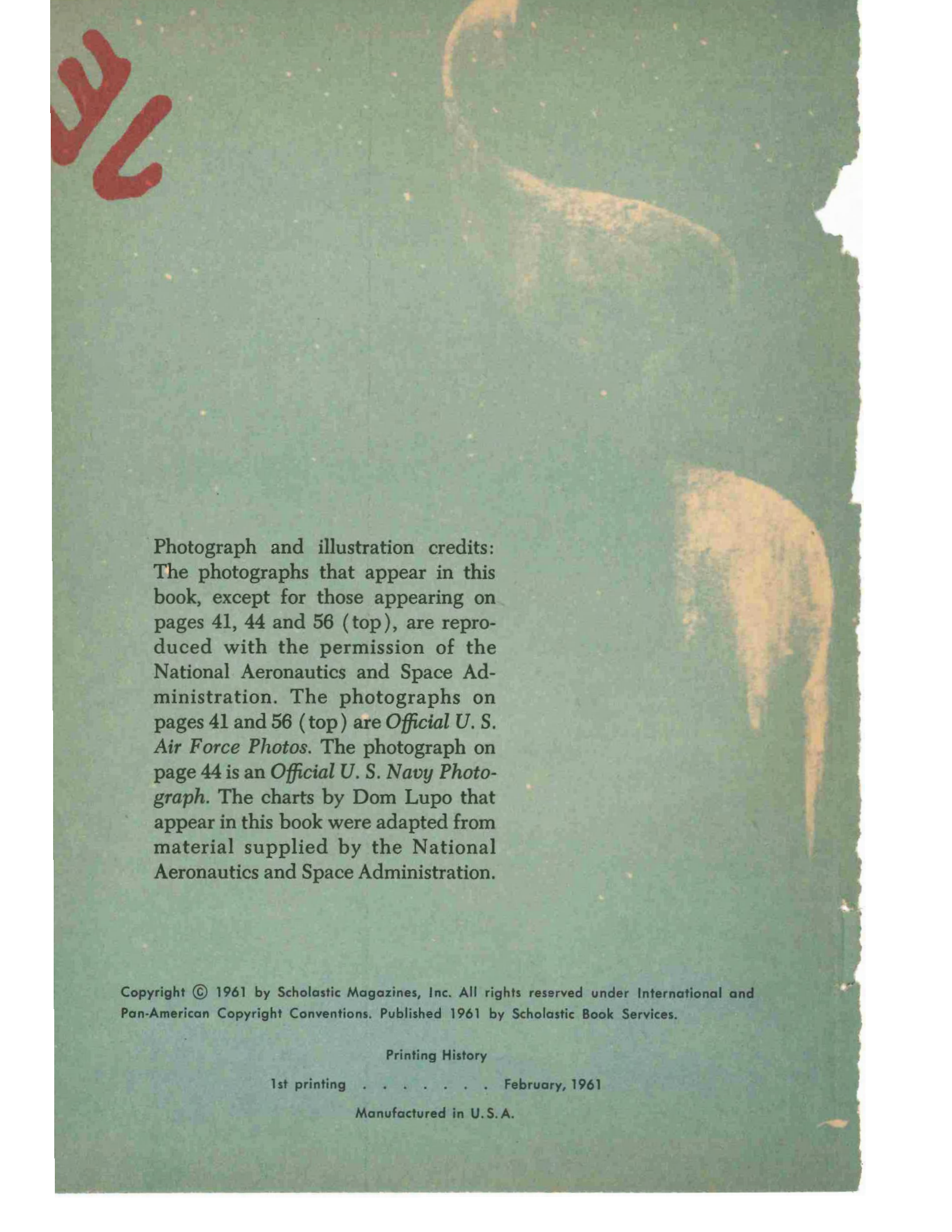
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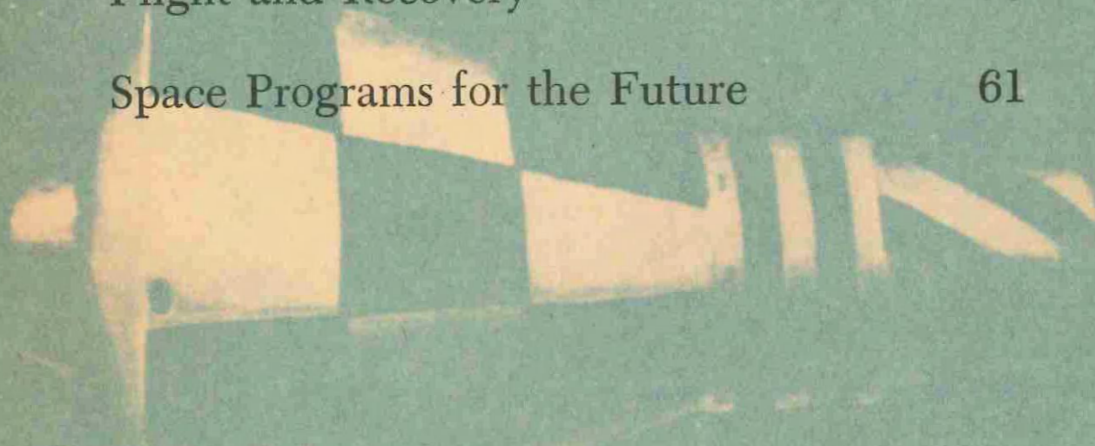
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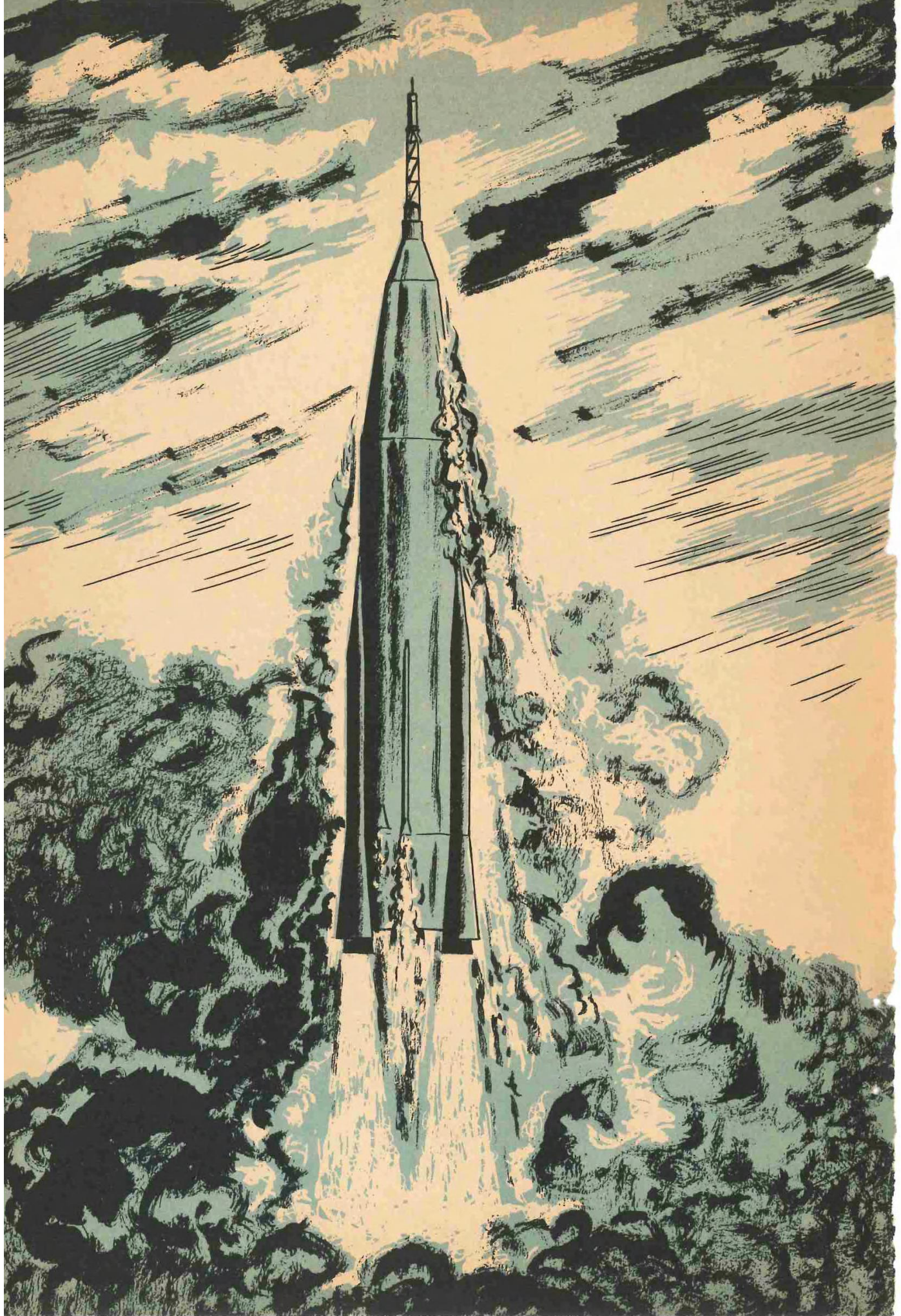
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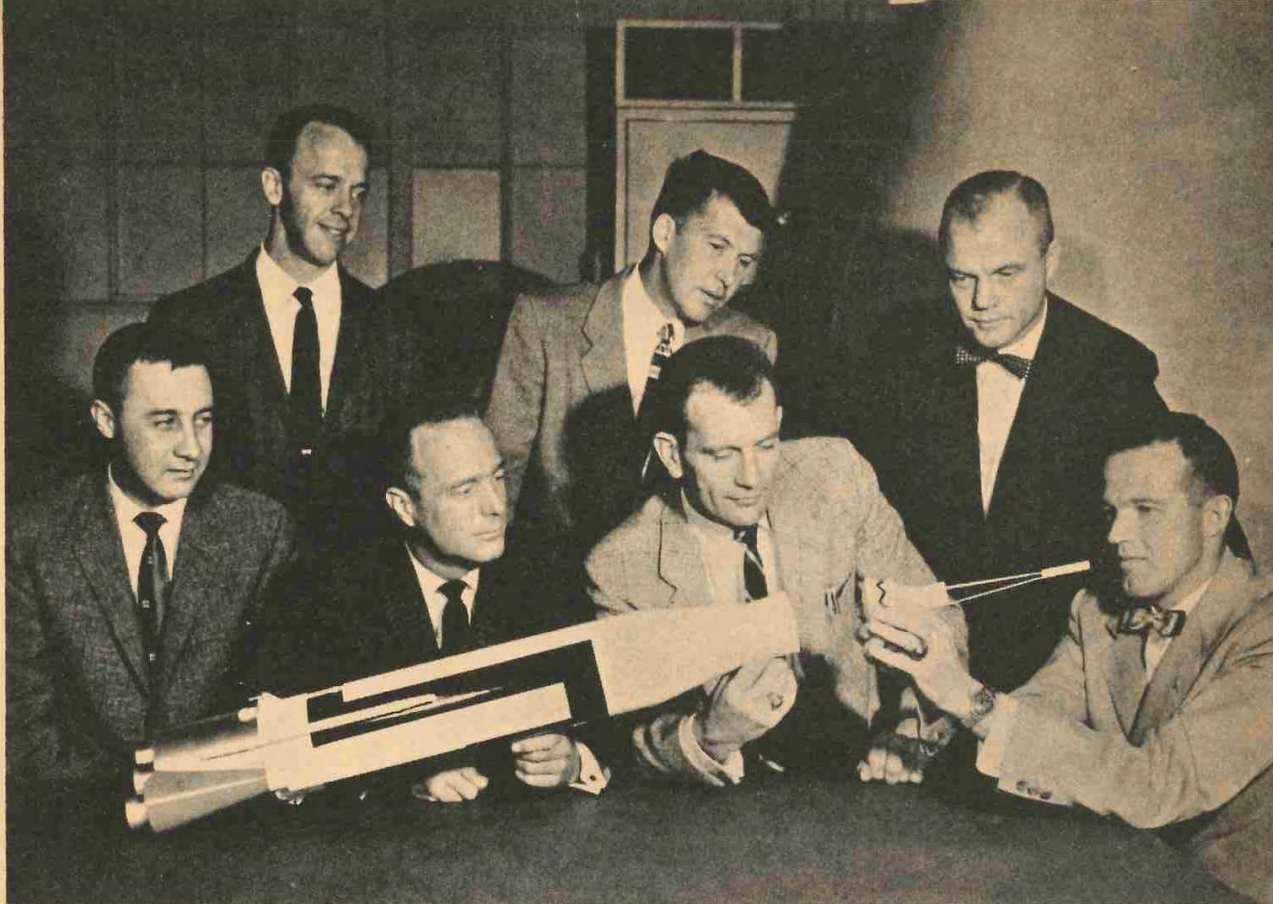
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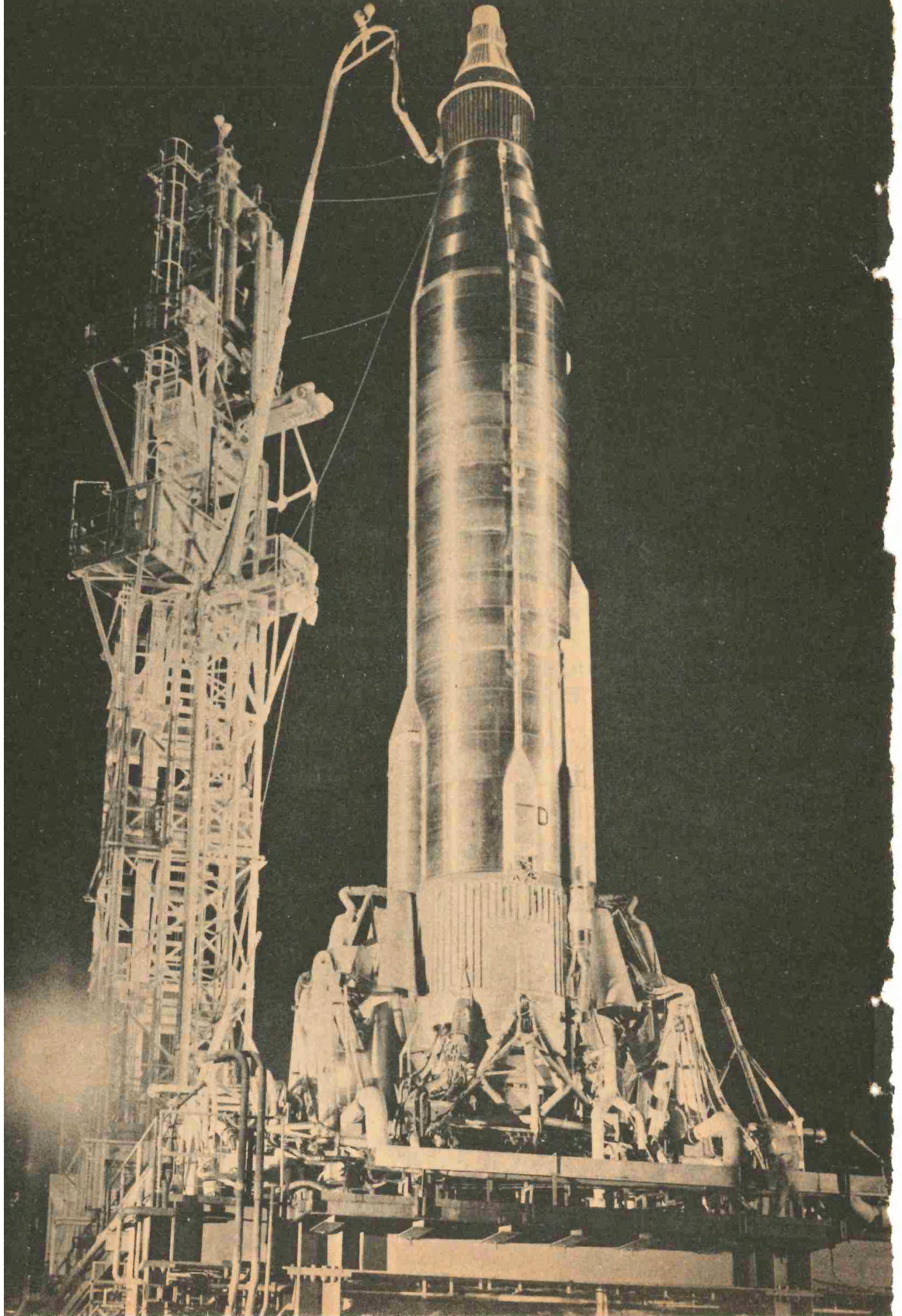






The astronauts study a model of the Mercury capsule and launch vehicle. Seated left to right are Virgil I. Grissom, Malcolm S. Carpenter, Donald K. Slayton, Leroy G. Cooper, Jr. Standing left to right are Alan B. Shepard, Walter M. Schirra, John H. Glenn, Jr.

H EADLINE—*The United States Orbits a Man in Space!* One day soon our morning newspapers will tell how a Project Mercury astronaut was blasted into space in a small “capsule” by a powerful Atlas-D rocket (see illustration left). What will the “Big Day” be like? And what of the research, hard work and training that led up to it? Let’s find out. . . .



THE BIG DAY

THE TIME: The Near Future

THE PLACE: Atlantic Missile Range, Cape
Canaveral, Florida

THE OCCASION: The First Attempt to Place
an American Astronaut in
Orbit Around the Earth

It is X minus sixty. In just sixty minutes, the first American astronaut will start a journey into space.

Almost three years of preparation have gone into this Big Day. Now the great Atlas-Mercury rests on its "pad," awaiting the historical moment. Atlas-Mercury is a ten-story-high "launch" vehicle. It is encased within a giant steel skeleton called a "gantry." The gantry rises ninety-five feet in the air. It has floors at several levels and an elevator to carry technicians up and down the structure.

At each of the gantry levels, workmen, scientists, and engineers make final checks of the various parts of the complex launch vehicle. These checks have been going on for several days. Nothing must be left to chance. Not only is a human life at stake, but the failure of a tiny part no bigger

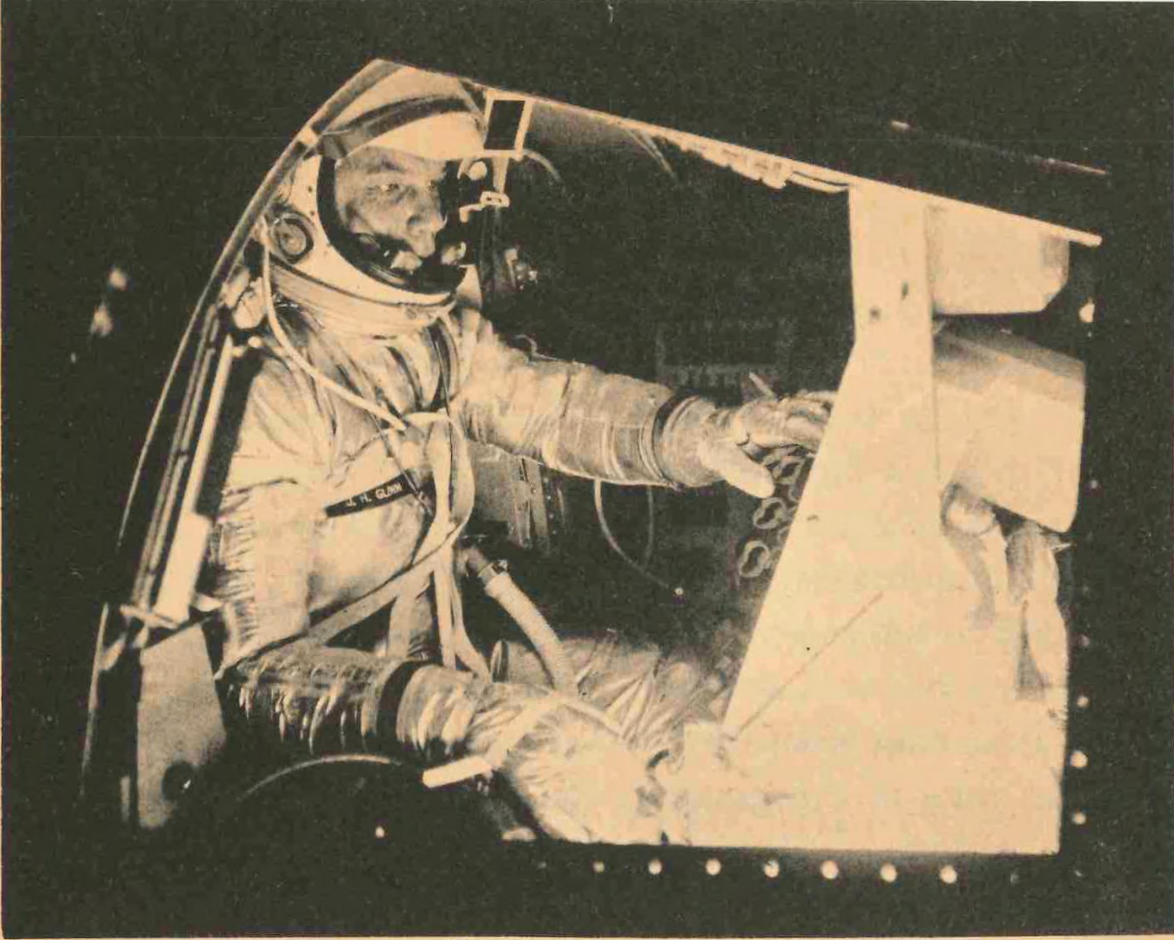
than a needle can wipe out one of the most important research projects in history.

Near the top of the gantry, a cluster of men gathers about the key man in the project, the astronaut. One of these technicians makes a final inspection of the astronaut's space suit. This suit is an aluminum-coated garment like the pressure suits worn by jet pilots, but it is especially designed to meet the hazards of space flight.

With a tap on the astronaut's helmet, the technician signifies that the suit is in perfect working order. Now the astronaut climbs through a hatch into the capsule he will ride through space. The technicians clamp on the hatch cover. They bolt it securely in place. Inside the capsule, the astronaut lies on his back on a couch and adjusts his safety straps. Then he reaches for a long list containing the things he must check carefully to make sure that all of his instruments and controls work perfectly. He starts to check each item.

It is now X minus thirty. The huge gantry is rolled away. The workmen and technicians leave the launching area. The majestic Atlas-Mercury sits alone on the pad, gleaming in the Florida sunlight.

The launch vehicle consists of three major parts. First, there is the rocket, a long cylinder which contains the automatic controls that steer the vehicle; the rocket fuel tanks; and the three mighty rocket tubes which will propel Atlas-Mercury. Two of these tubes are "boosters." They will burn up their fuel quickly and drop off. The third is the "sustainer." This one will continue to drive the vehicle until it is 100 miles high up in the sky.



On the "Big Day" the astronaut checks his controls and instruments just as John Glenn does in this "mock-up." A mock-up is a dummy capsule used to give the astronauts the "feel" of their home in space.

Second, on top of the rocket is the space capsule in which the astronaut will coast through space. Shaped almost like an ice cream cone, the capsule is ten feet high and a little more than six feet wide.

The third part of the launch vehicle is the escape rocket, to safeguard the astronaut in case something goes wrong. It looks like a giant firecracker and is mounted above the capsule, to which it is connected by three strong rods. Suppose a fire or an explosion occurred in the rocket during launch. The escape rocket would fire automatically, separating the space capsule from the launch vehicle. The blast would drive the capsule half a mile into the air. Then an

automatic parachute would lower the capsule and the astronaut gently to earth.

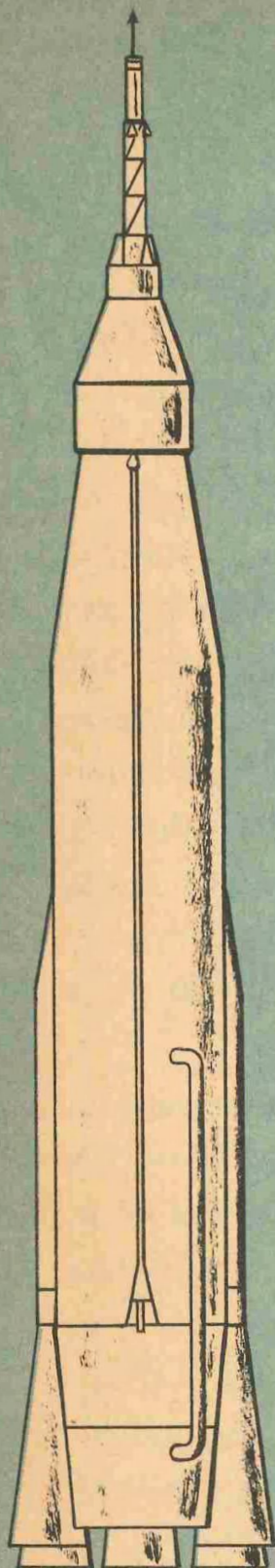
Now it is X minus fifteen. The final checks are almost finished. The tension mounts in the control room, which is located a few hundred yards from the launching pad. In this room are gathered many scientists and engineers, intently watching instruments, conversing on telephones, or watching the pad by television. They are in contact with other stations at Cape Canaveral and throughout the world, where a number of tracking groups will follow the progress of the mission.

The chief of the group in the control room is called the "test conductor." He sits before a large panel containing a great many colored lights. Each light represents some final check which must be made, and each light is red until the specific check has been reported "Okay." Then that light flashes green. Not until every light is green can the signal be given for the launch.

The test conductor faces a large screen, like a movie screen. The screen contains a map of the entire earth. Heavy lines on the map indicate the path the capsule will follow as it circles (orbits) the earth. Light signals along the heavy lines will show the capsule's position at all times.

It is X minus one. One minute to go. In the control room, all the lights are now green. Over a loud-speaker, a voice begins the "countdown," ticking off the seconds until launch. "Fifty . . . forty . . . thirty . . ." It is very, very quiet in the control room. "Five . . . four . . . three . . . two . . . one . . . Launch!"

Outside, on the pad, there is a burst of flame and a great



PROJECT MERCURY ORBITAL FLIGHTS

Conditions

Altitude . . . 120 miles

Velocity . . . 17,500 mph

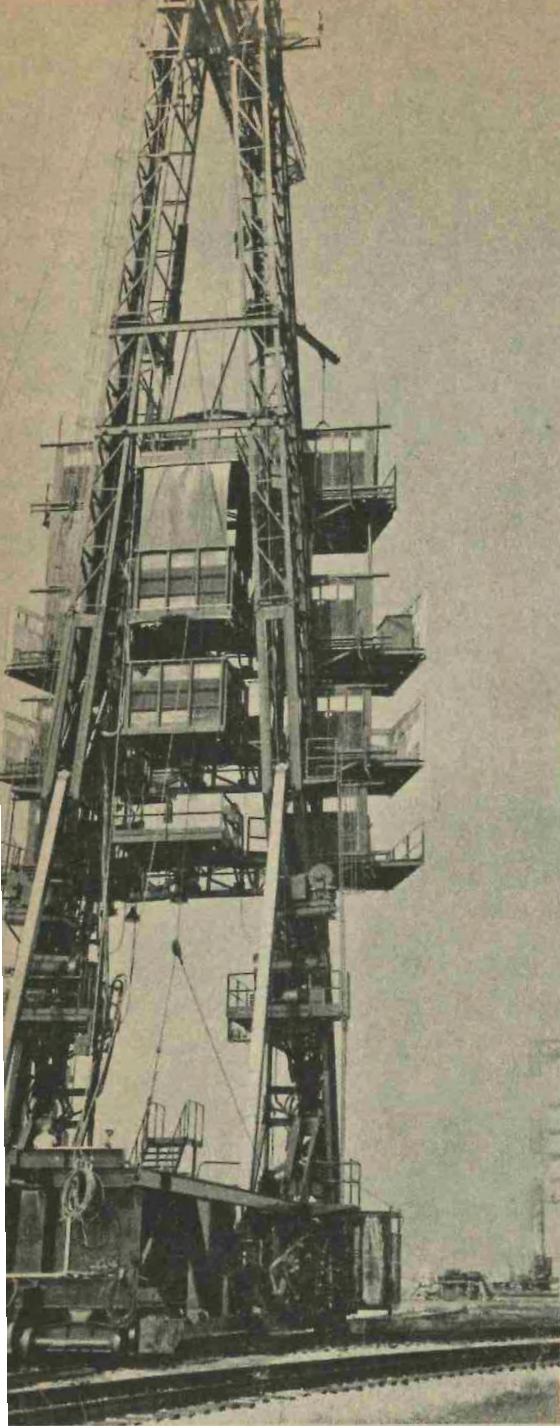
Time 4½ hrs, 3 orbits

Flight Missions

Instrumented Capsules

Animal Flights

Manned Flights



A huge gantry tower like this one is used to check the launch vehicle and capsule. While making their checks, technicians stand on "balconies" attached to the sides of the gantry.

roar. Atlas-Mercury seems to stand still for a few tense seconds. Slowly it starts to rise. Now it is picking up speed. Faster and faster it roars skyward, trailing a long tail of flame and smoke. So rapid is the rise that the astronaut is pushed deep into his "couch."

It is X plus two and one-half minutes. The two booster engines shut down and drop off. The sustainer engine continues to drive the vehicle faster and faster, higher and higher. Atlas-Mercury is headed east and slightly north, over Bermuda. Now it is turning slightly, moving at 15,000 miles an hour.

Then, at the terrific rate of almost 18,000 miles an hour, the vehicle reaches the point of orbit, 100 miles above the earth. The sustainer engine cuts off. The capsule separates and soars through space on its own momentum. Project Mercury is a success. This is the Big Day.

THE PROGRAM AND THE ASTRONAUTS

Project Mercury got its start in October, 1958. By that time, both the United States and the Soviet Union had launched six unmanned "satellites" into space. Others have been launched since then. Such satellites are very valuable to space research. They are equipped with fantastic instruments which have almost human intelligence. These instruments record information about space — how hot it is, how cold it is, how many meteorites are striking the satellite, how much magnetism surrounds the earth, and how intense are the rays from the sun and the other mysterious "cosmic" rays from outer space. Automatic radios in the satellite send this information back to the scientists on earth.

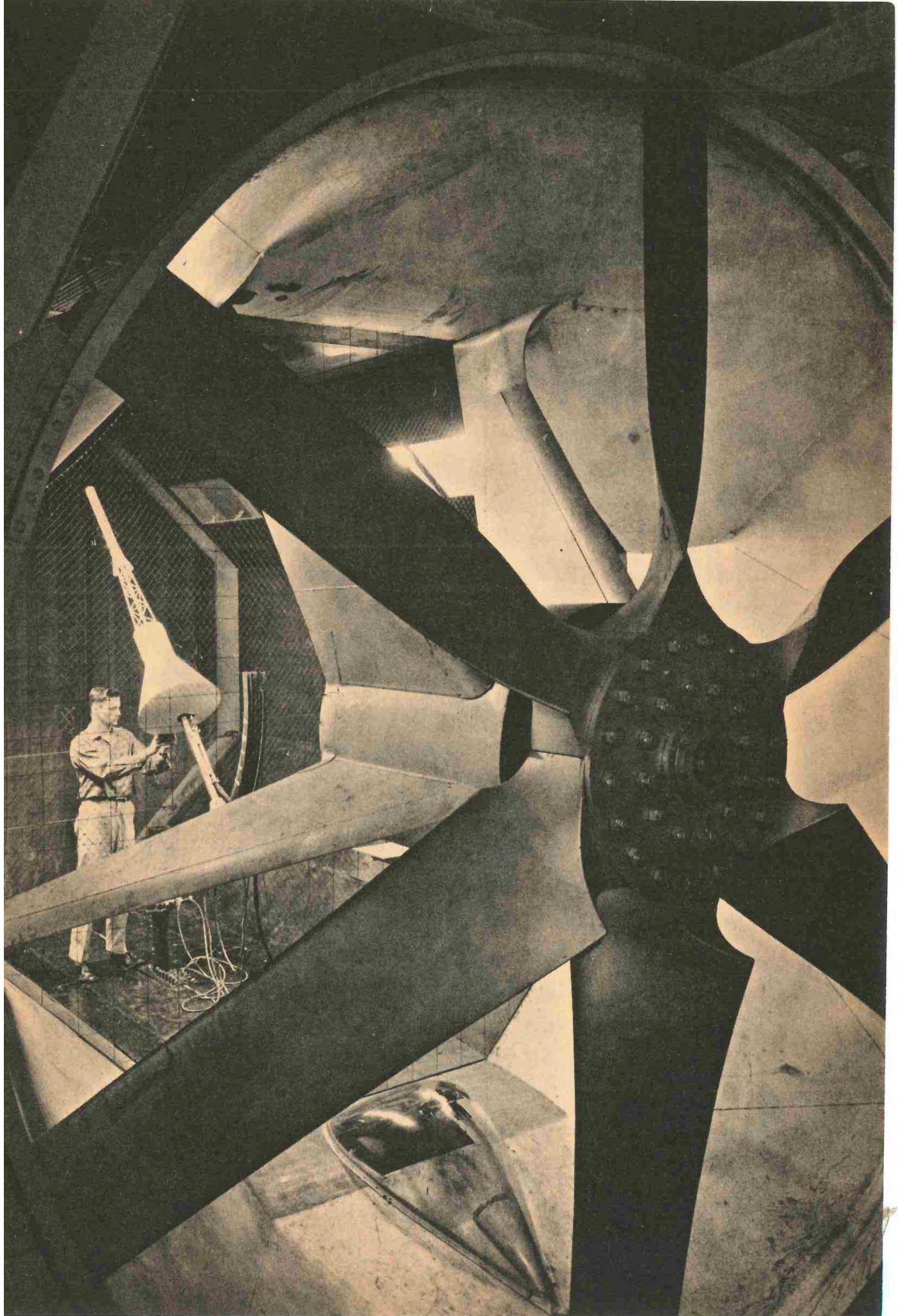
But the mysteries and wonders of outer space cannot be thoroughly investigated by instrument readings alone. Although the instruments in a satellite are in themselves scientific marvels, they are no match for the human brain. A satellite can take a picture of the back side of the moon and send it back to earth. But can this picture compare with

a human's view and description of this awesome sight? For real knowledge of space, man himself must venture out into the void beyond our atmosphere and make personal observations.

That is why, in October, 1958, the government of the United States told the National Aeronautics and Space Administration (NASA) to start a program to put man into space. This program was named Project Mercury.

Even in 1958, we had the rockets with which to launch man into space. With slight changes, our big missiles could be used for this purpose. The important job was to design a capsule in which man could survive in space, when it is sometimes very hot, sometimes very cold, where deadly cosmic rays threaten human life, and where there is no air to breathe. Above all, the capsule would have to bring the man safely back to earth. A safe re-entry raised the great problem of combating the friction heat which builds up on re-entering the atmosphere after a trip into space.

What causes friction heat? The layer of atmosphere around our planet is composed of billions and billions of tiny air molecules. When an object from outer space enters this atmosphere at great speed, each of the air molecules moves over its surface at similar speed, causing friction. To get an idea of this friction, rub your hand rapidly on your desk. You will notice that your hand becomes warm. Multiply this slight temperature increase by many thousands of times and you will understand what happens to an object crashing through the layer of atmosphere at tremendous speed. This is what happens to meteors entering our atmosphere. Because



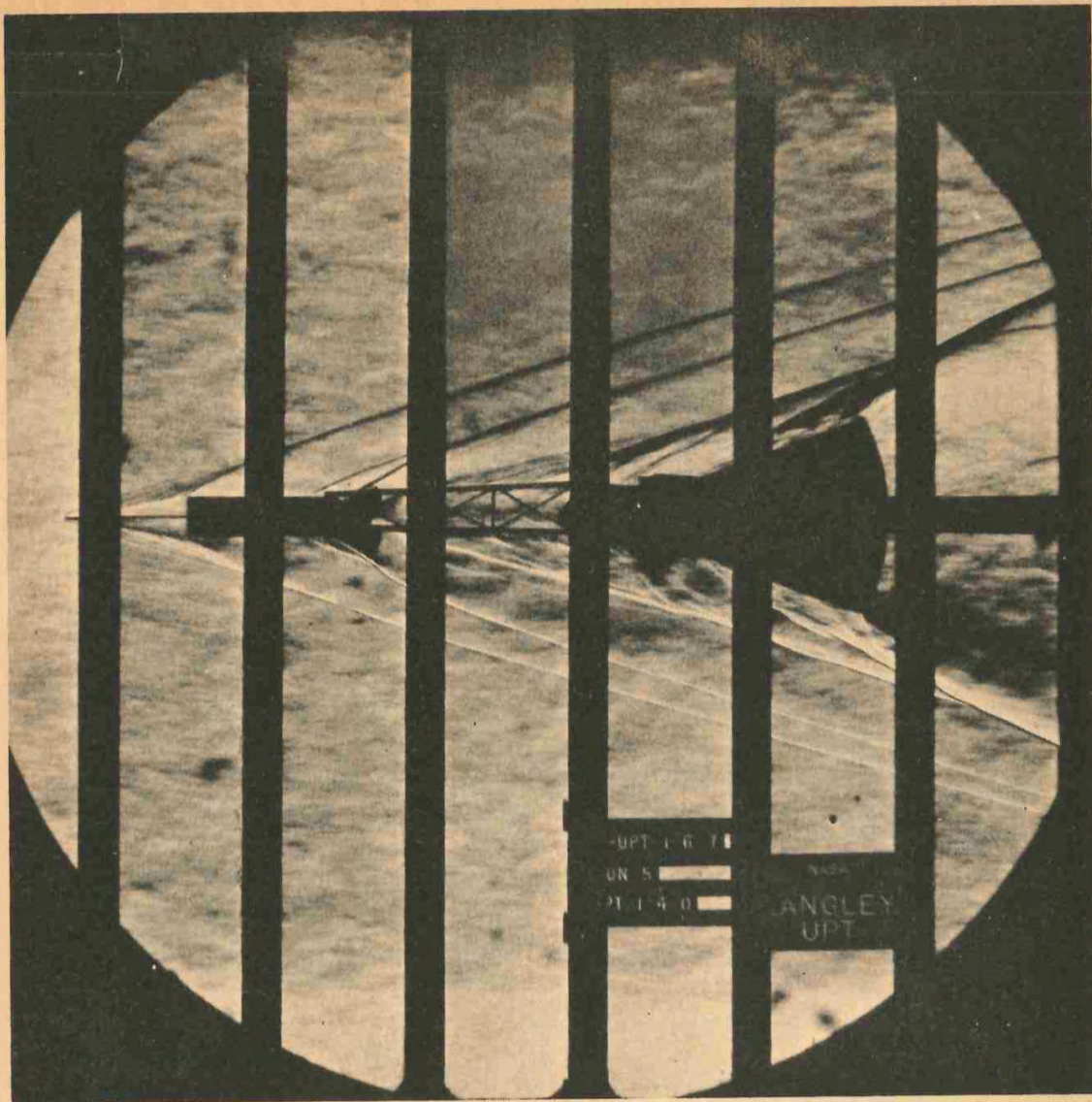
of the incredible speed at which they travel and the friction that speed builds up, most meteors burn up immediately.

The Mercury capsule will re-enter the atmosphere at a speed of more than 15,000 miles per hour. At this speed, it will encounter what is called "re-entry heating." The air friction on the capsule will build up a temperature of more than 3,000 degrees Fahrenheit, hotter than a blast furnace that makes iron. How do you protect the astronaut against such heat? Scientists knew that this protection must be built into the capsule design.

For two years before the official start of the Mercury program, scientists investigated a number of possible designs for manned capsules. They built small models and tested them in wind tunnels. In these tunnels, high-speed winds were created by big propellers driven by giant turbine engines. The winds were blown over the capsule in the "test section" of the tunnel. This simulated the movement of the capsule through the air. These tests were made to find out if the capsule is "stable," that is, if it would return to earth in a vertical position without tumbling end over end. In very high-speed wind tunnels, the problem of friction heating was investigated.

By October, 1958, the scientists felt they had the proper design as far as capsule flight through *air* was concerned. There remained the task of testing the capsule in space, where there is no air. This could be done only by building full-scale models and launching them into space.

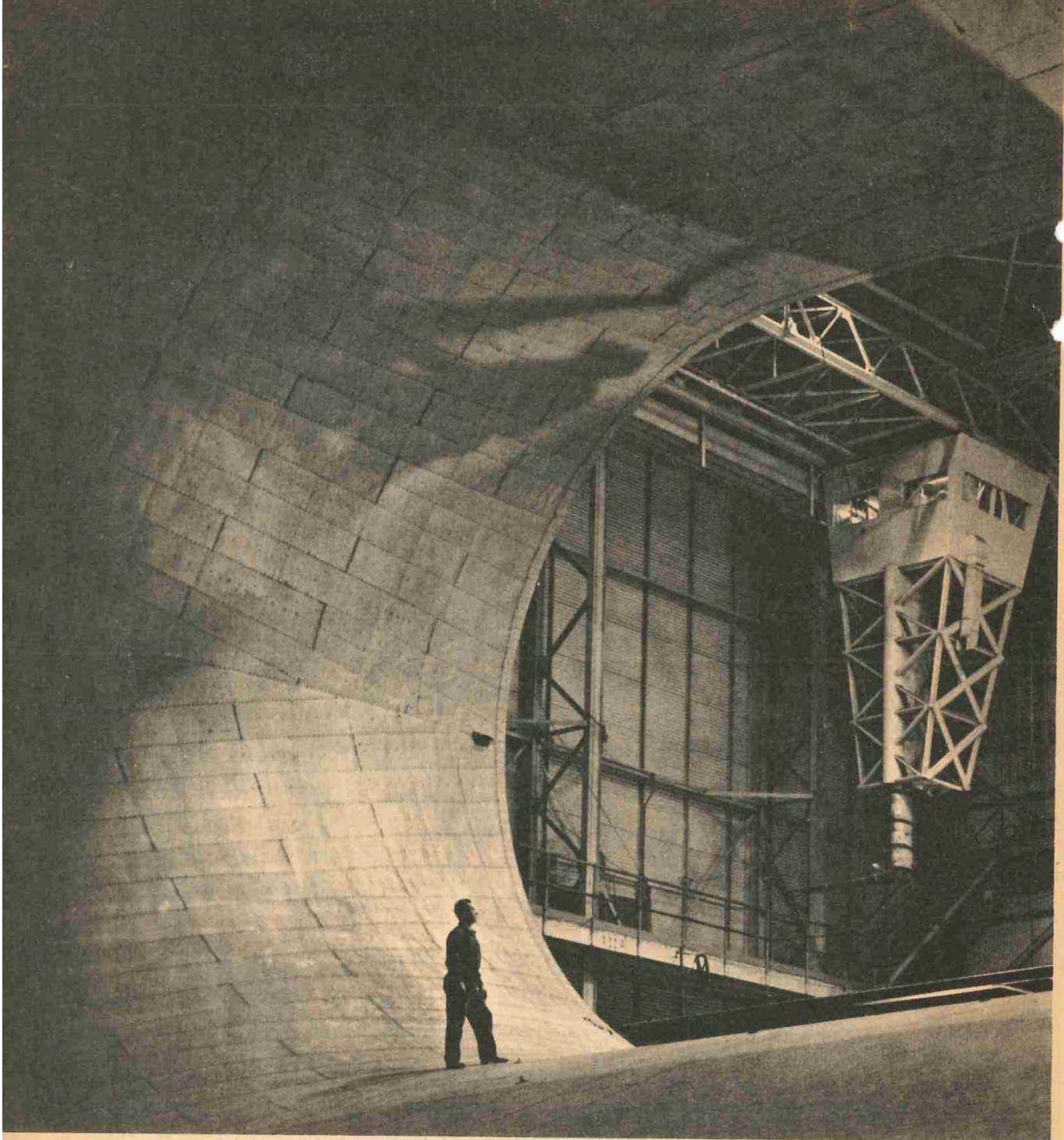
Project Mercury scientists and engineers decided to build twenty-four capsules for test and actual space flight. At the



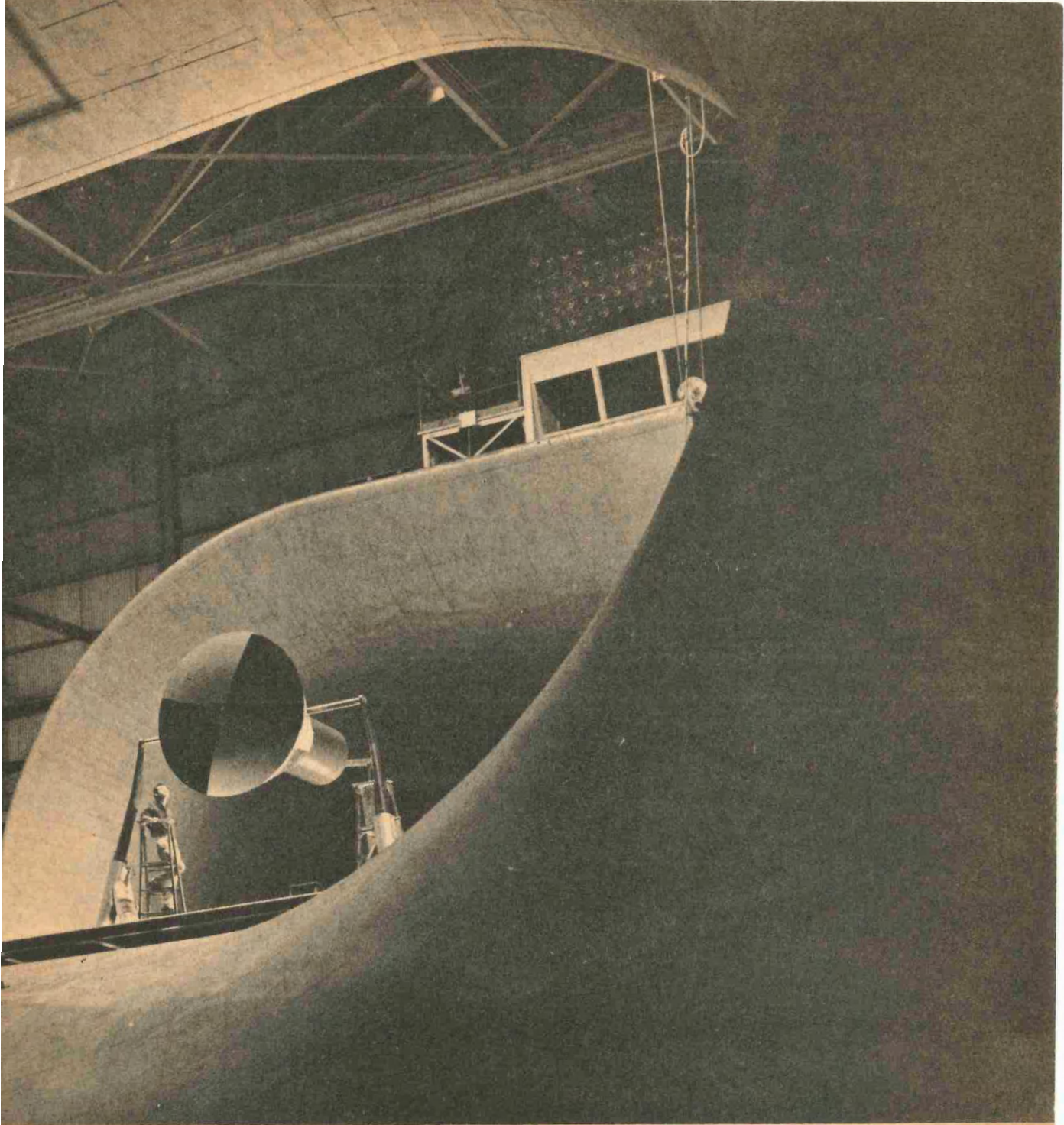
"Shock waves" build up around a model of the Mercury capsule and escape tower in a wind tunnel at four times the speed of sound (about 2,600 miles per hour). Tests like this determined the capsule's shape.

same time, work was started on the launch vehicle, the escape system, the elaborate communications network which would be required, and the many other parts which go to make up Project Mercury.

Now came the big step. Who was to be America's first space man? What does it take to be an astronaut? A space man must be in perfect physical health to survive the rigors



Technicians of the National Aeronautics and Space Administration prepare a model of the Mercury capsule for a test in the Full Scale Tunnel at the Langley Research Center. This wind tunnel test was a part of the very important testing program that determined the proper shape of the capsule.



of space flight. He must have great courage. He must have a college education in engineering or science; he would need this to understand the scientific training he would receive before being sent into space. He must have a high degree of flying skill and co-ordination.

Lieutenant Malcolm S. Carpenter, U. S. Navy, is 35, married, and has four children. He is 5 feet 10½ inches tall and weighs 160 pounds. He flew antisubmarine patrol during the Korean War and has 2,800 flying hours, 300 in jets.

Captain Leroy G. Cooper, Jr., U. S. Air Force, is 33, married, and has two daughters. He is 5 feet 9½ tall and weighs 150 pounds. Cooper has 2,300 flying hours, 1,400 in jets. He is the only astronaut with no combat duty.

Lieutenant Colonel John H. Glenn, Jr., U. S. Marine Corps, is 39, 5 feet 10½ inches tall and weighs 180 pounds. He is married and has a son and a daughter. He flew 59 combat missions in World War II and 90 more in Korea, where he destroyed three enemy planes. Glenn has more than 5,000 flying hours, 1,500 of them in jets.



Carpenter



Cooper



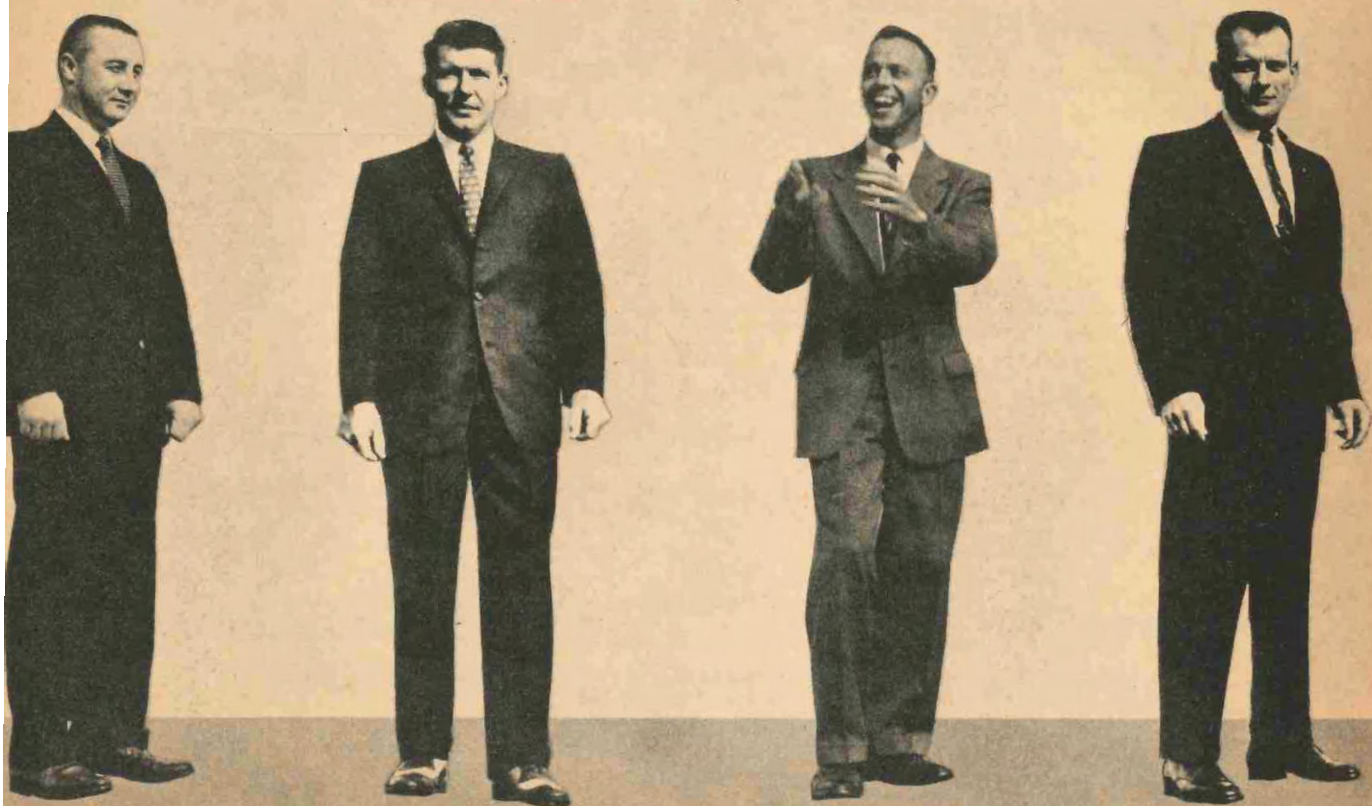
Glenn

Captain Virgil I. Grissom, U. S. Air Force, is 34, 5 feet 7 inches tall and weighs 155 pounds. He is married and has two sons. Captain Grissom flew 100 combat missions in Korea and has more than 3,000 flying hours, 2,000 in jets.

Lieutenant Commander Alan B. Shepard, U. S. Navy, is 37, 5 feet 11 inches tall and weighs 160 pounds. He is married and has two daughters. Shepard graduated from the U. S. Naval Academy in 1944. He has 3,600 flying hours, 1,700 of which have been in jets.

Lieutenant Commander Walter M. Schirra, U. S. Navy, is 37, 5 feet 10 inches tall and weighs 185 pounds. He is married and has a son and a daughter. Schirra flew 90 combat missions in Korea, downing one enemy plane. He has 3,000 flying hours, 1,700 in jets.

Captain Donald K. Slayton, U. S. Air Force, is 36, married, and has a son. He is 5 feet 10½ inches tall and weighs 160 pounds. Slayton flew 63 combat missions during World War II. He has 3,400 flying hours, 2,000 in jets.

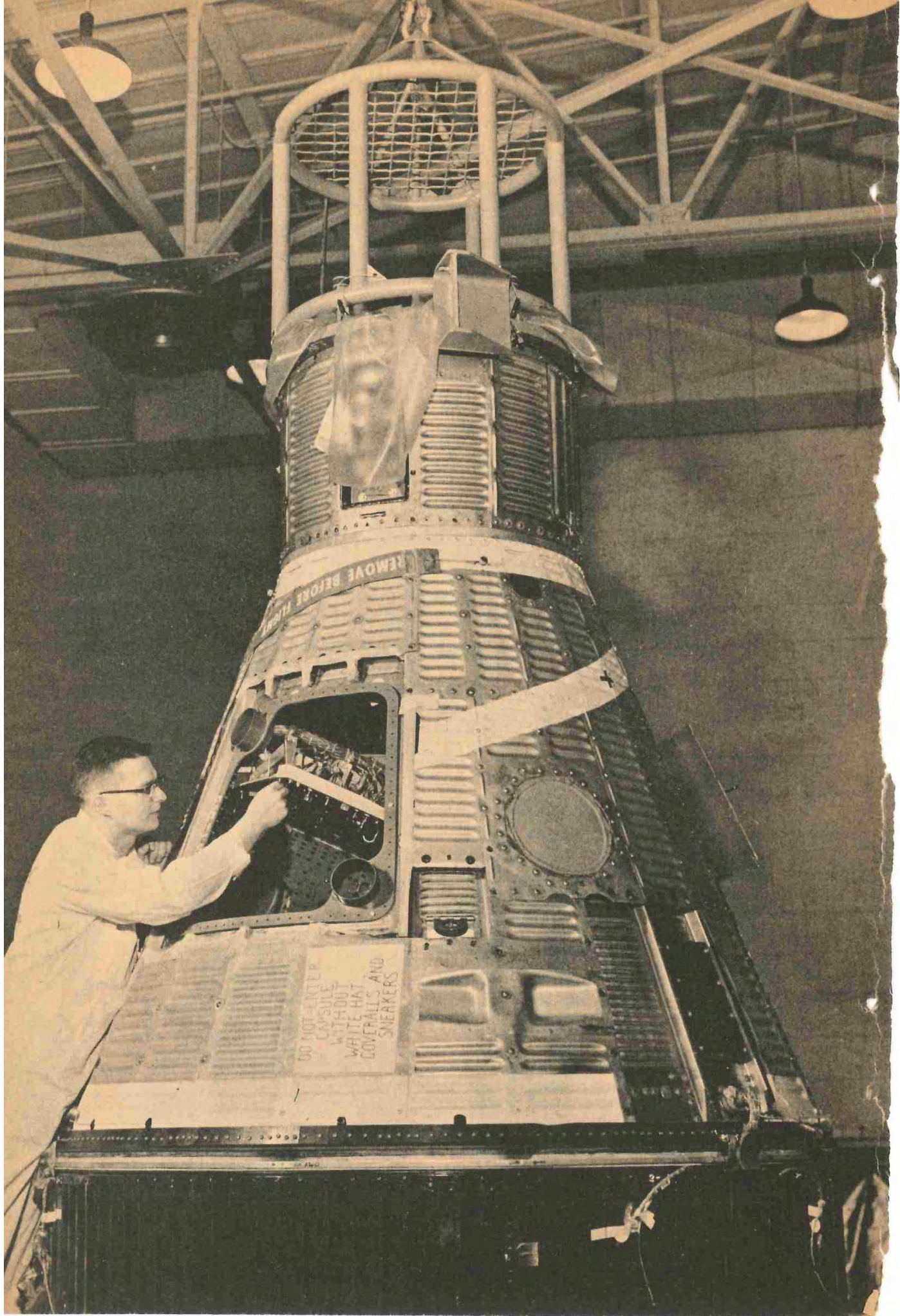


Grissom

Schirra

Shepard

Slayton



The scientists of the NASA realized that there was a special group of men who met all these requirements: the nation's military test pilots. NASA scientists decided that a test pilot would be ideal for the job, but added other requirements. The astronaut must have at least 1,500 hours of flying experience, he must be thirty-nine years of age or less, and he must not be more than five feet eleven inches tall. This latter rule was made because of the size of the capsule. The size, in turn, had been determined by the amount of weight the available rocket booster — the *Atlas* missile — could hurl into space.

There were hundreds of volunteers for the job. From their ranks, NASA selected the thirty-two military test pilots who seemed best qualified. These thirty-two were put through a long series of physical and mental tests. Finally, seven were picked for the most exciting job of all time.

No one knows which of these seven will be the first into space. Just before the great journey the selection will be made. It will be kept a closely guarded secret until one of the men is told to put on his space suit.

With selection of the astronauts completed early in 1959, NASA embarked on a long, two-part program. First, the space agency had to train the astronauts as thoroughly as was humanly possible. Secondly, NASA had to test every single part of the Mercury system to insure perfection before the "countdown for space" was started. But before we take up these two points, let's find out about the space "hardware" — the machines, equipment, and electronic devices — and the people that make up Project Mercury.

SPACE HARDWARE AND PEOPLE

What kind of vehicle did the scientists and engineers design for the first American effort to put man into space? Let's take a closer look at the various sections of Project Mercury. And remember that there is more to sending a man into space than designing and constructing the airborne section. The people and equipment and buildings on the ground are just as important. Let's imagine how all these sections will work together in Project Mercury.

1. The Airborne Section of Project Mercury

This section is made up of the parts that fly. It is called the "flight vehicle" and must fly first within the atmosphere and later in space. The flight vehicle has three major parts: the launcher, the capsule, and the escape rocket.

THE LAUNCHER

The launcher is an Atlas-D intercontinental ballistic missile and is more than seventy feet high, or taller than a seven-story building. The long cylindrical frame contains the rocket fuel (kerosene and liquid oxygen) tanks and the complicated guidance equipment which directs the capsule to the very precise point in space at which it enters orbit. Atlas has three rocket engines. Two are "boosters" that blast for 150 seconds and then drop off. The third engine is a "sustainer." It fires until the capsule reaches the start of orbit. The combined engines develop 360,000 pounds of thrust. Rocket "push," or power, is measured in pounds of thrust. One pound of thrust is *roughly* equal to one horsepower.

THE CAPSULE

The capsule is ten feet long and slightly more than six feet wide at its bottom. The cone-shaped main section is the "cockpit" and houses the astronaut. For take-off, the astronaut lies flat on his back on a specially fitted foam-rubber couch. Directly above him is the instrument panel. This tells him how all of his equipment is working.

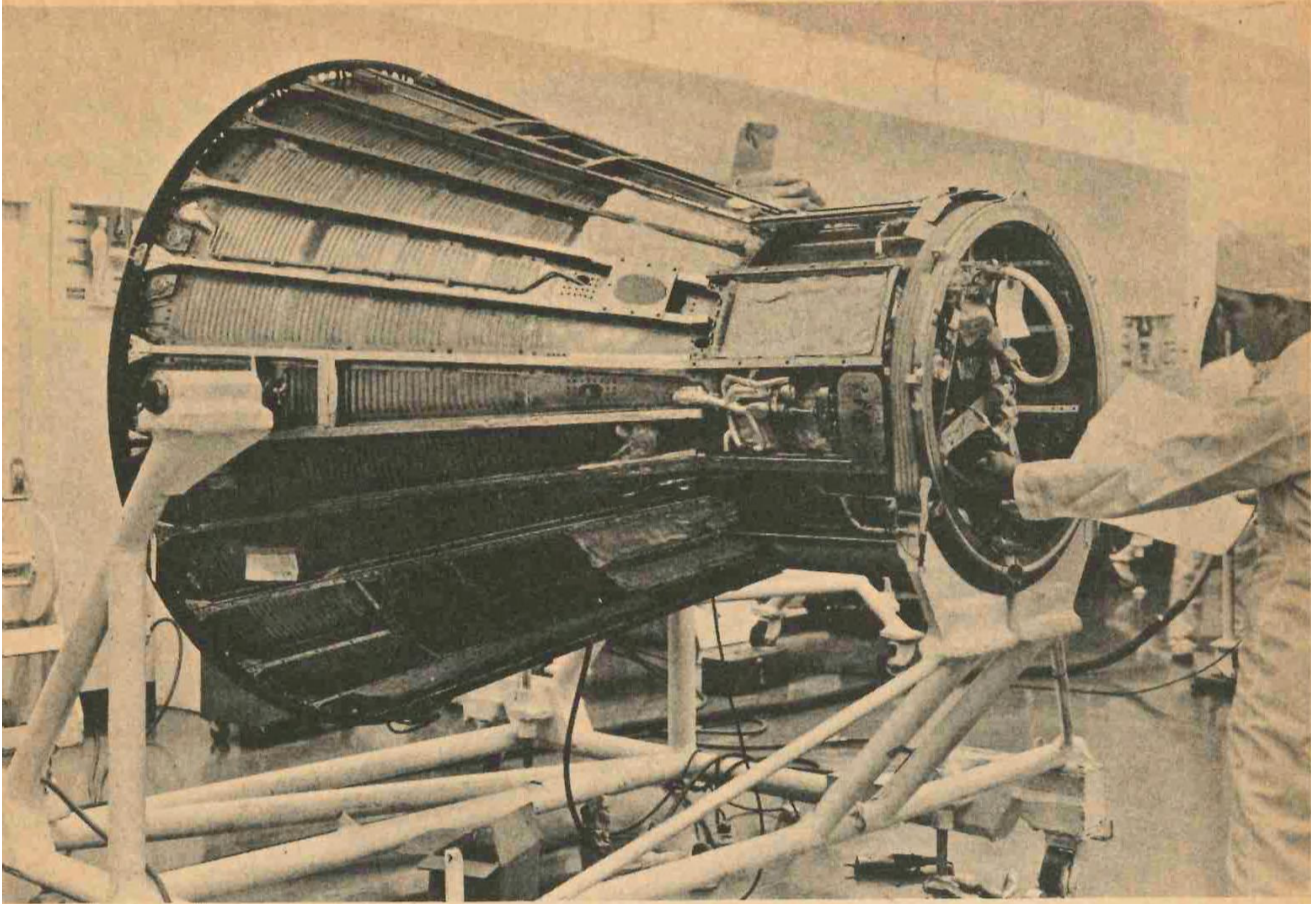
Beneath the couch are the "black boxes," radio equipment which enables the astronaut



to converse with the stations on the ground. Over his head is a navigation periscope through which the astronaut can see where he is in relation to the surface of the earth. On either side of the couch are control handles, like the control stick in a jet fighter plane. The handle on the right is used to change the position of the capsule. It sets off tiny jets located on the top and bottom of the capsule. These jets turn out only a few pounds of thrust, but that is all that is needed in space, where there is no air resistance to overcome. A short blast with the proper jet will move the capsule up and down or from side to side. Twisting the handle on the left will set off the escape rocket if it should become necessary.

The stability necessary to keep the capsule from going end over end or whirling was built into the design as in an airplane. Once the astronaut guides it into proper position by using his control jets it should stay that way, since there is practically no air to disturb it. Slight bumps by meteorites might start it rolling or yawing (turn it from its line of flight), but the astronaut can correct this with the control jets. Tests have proved that the capsule has stability.

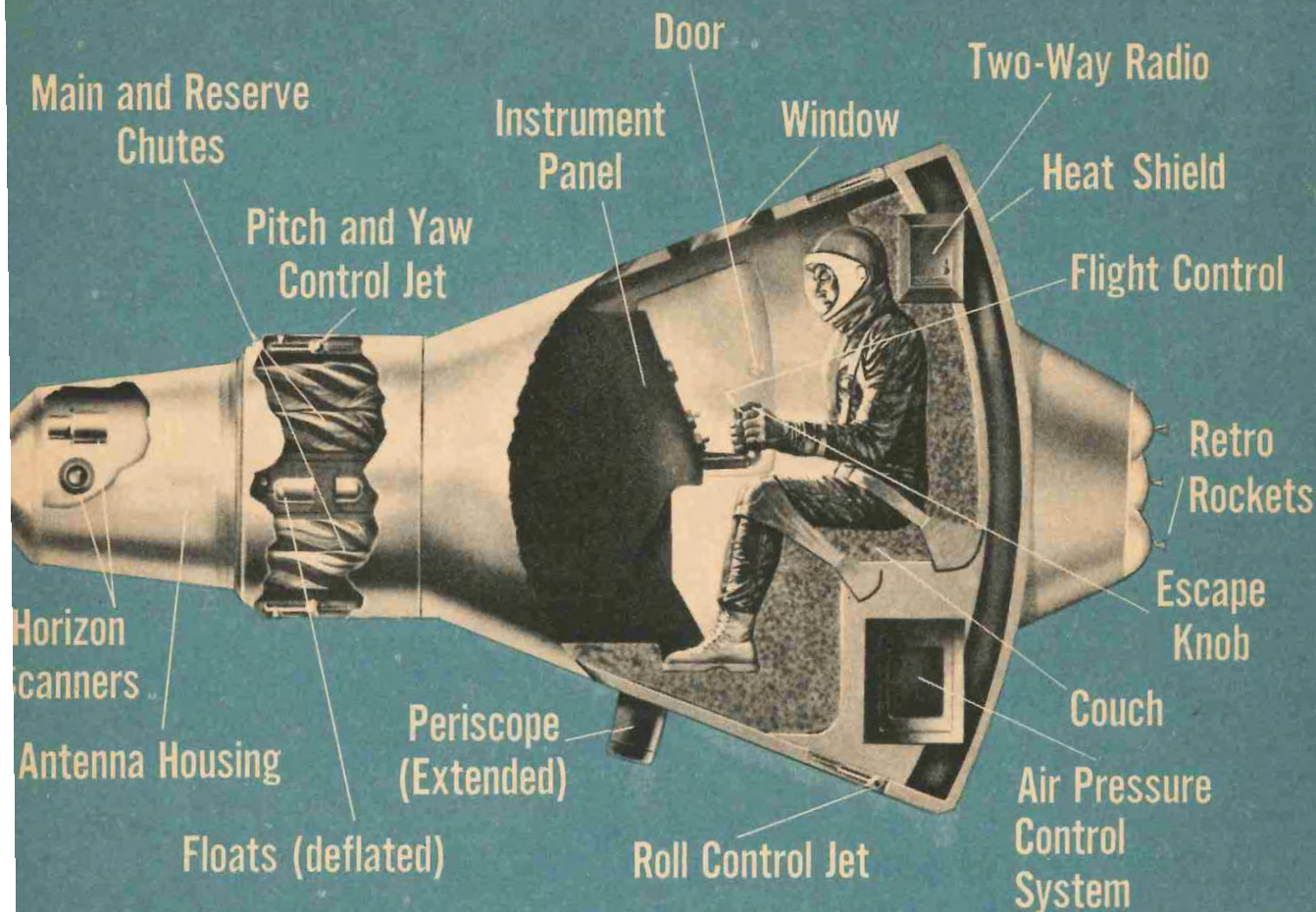
The capsule is "pressurized" like a jet plane. The astronaut can breathe normally in the cabin as long as the pressure system works properly. If the pressure system fails, the astronaut's space suit goes into operation automatically. Oxygen is pumped into the helmet of the suit through a tube. The harmful carbon dioxide the astronaut exhales is forced out of the suit through another tube. A control system keeps the temperature inside the cockpit comfortable although it may be very cold or very hot outside.



Mercury capsules must be assembled in absolutely clean rooms, to prevent dust or other particles from clogging the delicate equipment in the capsule. An assembly room is kept as clean as a hospital — even workmen dress like doctors.

Wires connect parts of the astronaut's body to medical instruments within the cockpit. These instruments send their information back to earth. They tell a physician in the control center the astronaut's breathing rate, body temperature, heartbeat, pulse and other vital details of his physical condition. If the physician feels the astronaut is in danger he tells the test conductor, who can bring the capsule back to earth if the situation is serious. This is what would happen, for instance, if the astronaut's heart beats too rapidly or he does not get enough oxygen.

Above the cockpit is the tubelike portion of the capsule



This is a cutaway view of the Mercury capsule. Since changes and improvements are constantly being made, the capsule may look slightly different on the "Big Day."

which contains the parachutes. One chute is for lowering the capsule to earth after re-entry. The other is the emergency parachute for use with the escape rocket in case of rocket failure at low altitude.

Below the cockpit is the "heat shield." This is a heavy layer of material called Fiberglas. It protects the capsule and the astronaut from the great heat built up by air friction during re-entry.

Between the heat shield and the cockpit is a rubber cushion. It inflates like a balloon as the capsule is lowered to earth, softening the shock of landing.

On the very bottom of the capsule, below the heat shield, are six small rockets. Three of them are used to blast the capsule away from the launcher when the point of orbit is reached. What about the other three? They are extremely important. To bring the capsule back from space, the astronaut must first slow it down. If the capsule kept going at its original speed, it would stay up forever. These other three rockets are the vital "space brakes." They are called "retro rockets." They fire *toward* the direction of flight, creating a braking force to slow the capsule down. As the capsule loses speed, it also loses altitude and starts down to earth.

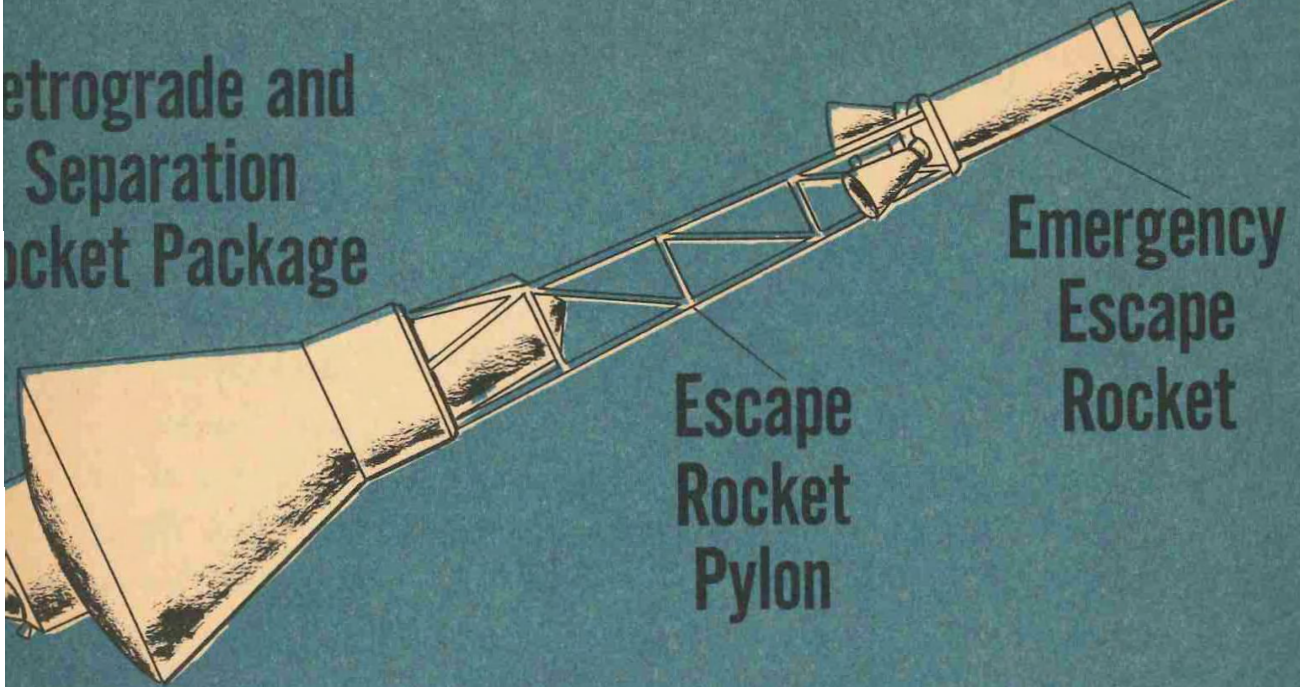
When the capsule enters its orbit, the astronaut operates his control handle so that the capsule changes position. Instead of lying down, he is then sitting upright facing away from the direction of flight, or going around the world backward. The position of the capsule is also very important on re-entry. The astronaut must maneuver again so that the heat shield on the bottom hits the atmosphere first. As the friction heat builds up, a part of the Fiberglas shield actually melts. The melting absorbs the heat, and the heat energy is used up on the shield so that it does not spread to the rest of the capsule. Since the melting process lasts only a few seconds, while the capsule is slowing down rapidly, the melting does not seriously damage the capsule. This way, the shield absorbs the friction heat and protects capsule and astronaut.

retrograde and
Separation
Rocket Package

Aerodynamic
Spike

Emergency
Escape
Rocket

Escape
Rocket
Pylon



This model shows how the escape rocket is attached to the capsule.

THE ESCAPE ROCKET

There is a small tower on top of the capsule. At the top of the tower is the escape rocket. It has three tubes, or nozzles, which can pour out rocket thrust to blast the capsule away from the launcher should something go wrong in the early part of the flight. Who decides when to fire this escape rocket? Answer: Whoever learns first of the failure. It can be the astronaut, who would know of the danger from the instruments in the capsule. It can be the test conductor on the ground who has similar instruments on his panel. Or it can even be the launching vehicle. This rocket contains one of those "intelligent" automatic devices which can "sense" a failure and trip a switch to set off the escape rocket. Once

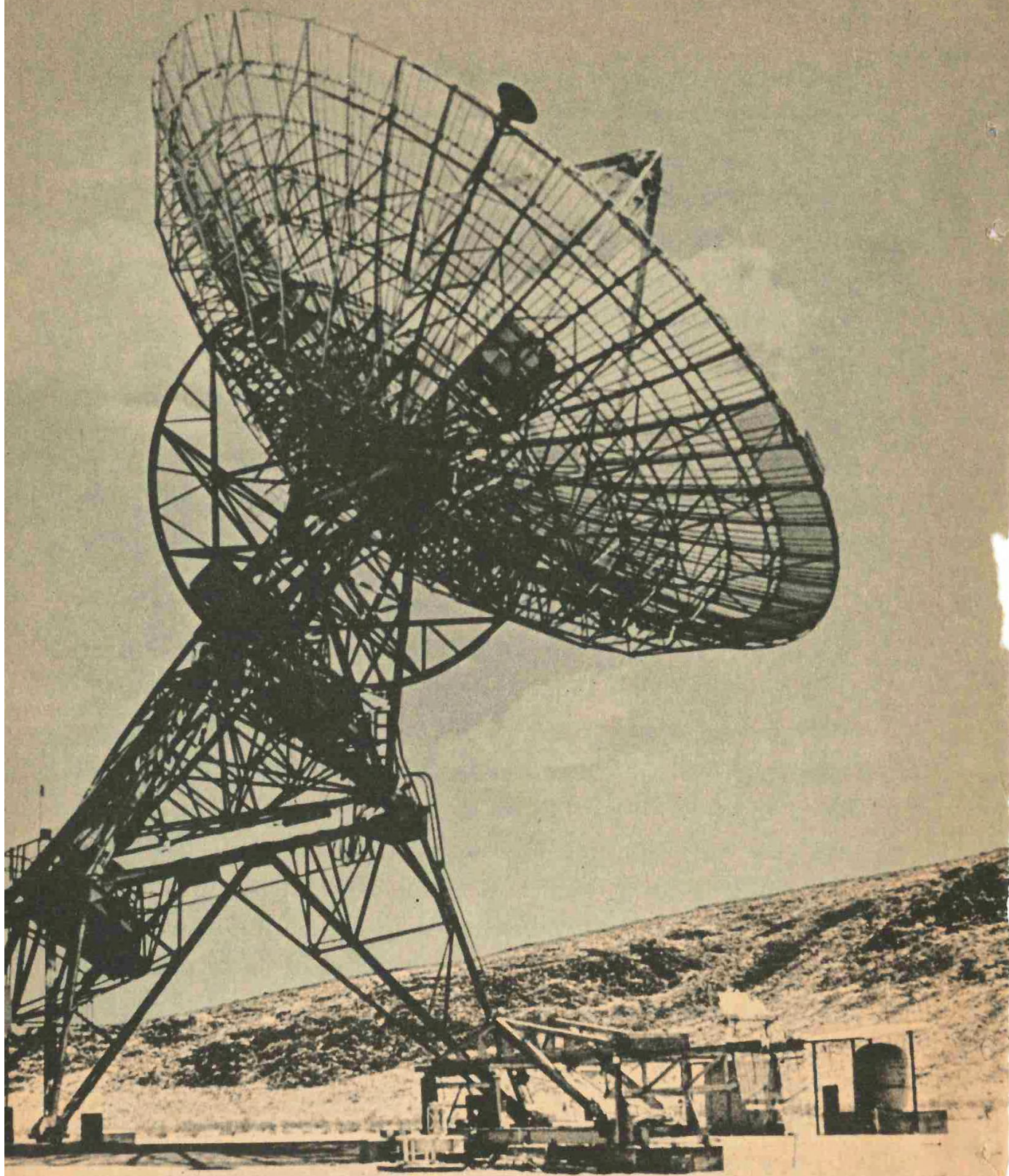
touched off, the escape rocket propels the capsule a couple of thousand feet in the air, providing height for the emergency parachute to open. The parachute then lowers the capsule to the ground. If all goes well during the launch, the escape rocket and its tower are blown away from the flight vehicle by a small rocket. They fall to earth before the capsule reaches its point of orbit.

2. Mercury's Sections on the Ground

Just as important to the success of Project Mercury are the sections which do not leave the ground. They include the control center, the tracking network, and the recovery group.

THE CONTROL CENTER

The control center is people and instruments. The vast array of instruments tells what is happening. The people decide what to do about what is happening. Located at Cape Canaveral, the control center is the hub of activity. The first job of the men in the center is to watch the launching carefully. By television and instrument readings, they make sure everything is going well. If it is not, the test conductor—the head man in the control center—can cancel the mission and set off the escape rocket. Once the capsule is in orbit, the control center staff maintains communication with the astronaut by radio, double-checking his every action. The control center is also in touch with the tracking stations all over the world. The center advises the astronaut of the precise moment to start his re-entry, and follows his progress until he has been safely recovered.



Giant radars such as this one will keep track of the Mercury capsule during its flight through space. The radar operators can continually report to the control center by radio.

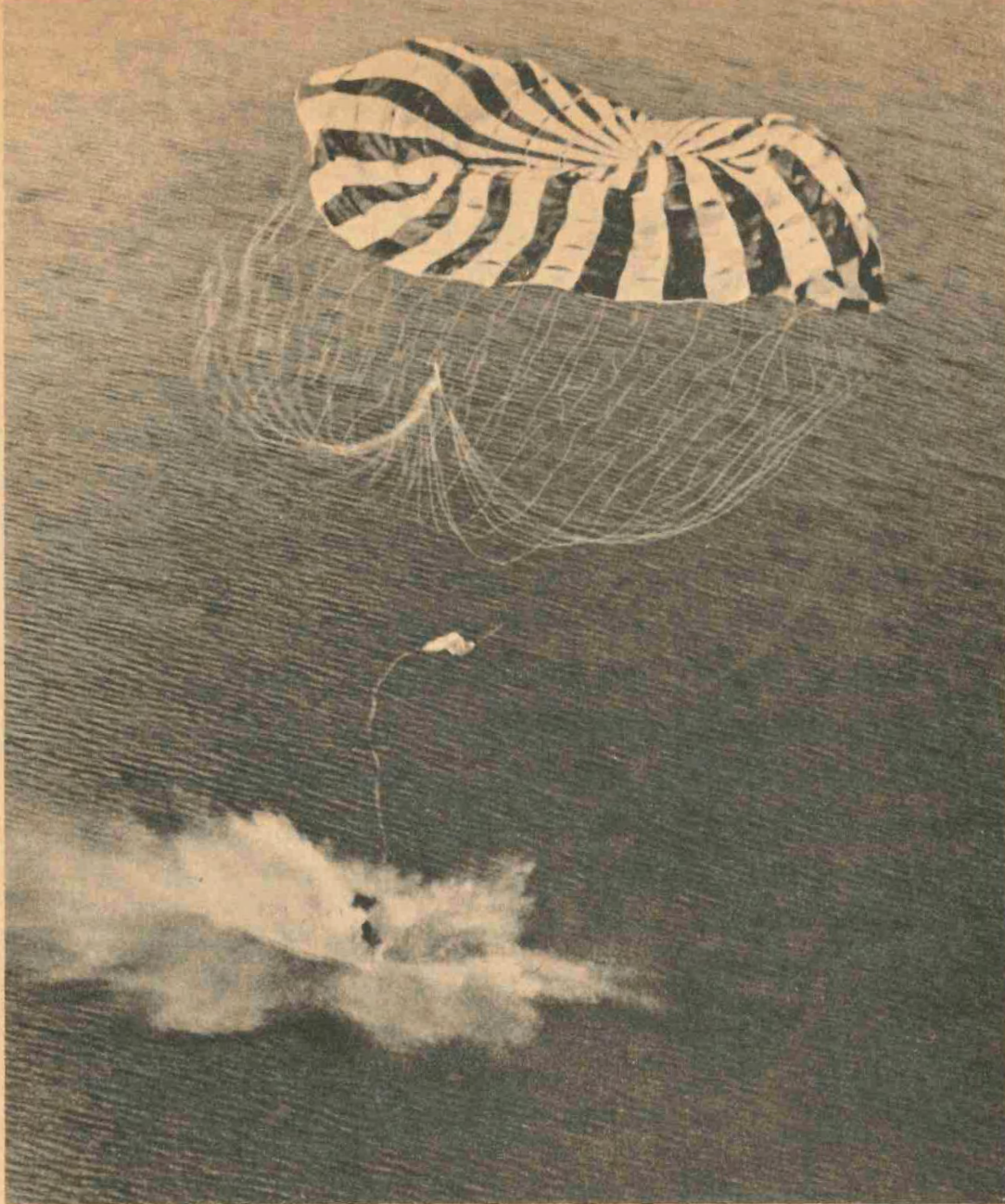
THE TRACKING NETWORK

The tracking network is also composed of people and instruments. In addition to the control center, sixteen other stations all over the world follow the progress of Project Mercury from start to finish. Five of these stations are located in the United States, beneath the path of the capsule as it moves across the country. There are three more stations in Africa and two in Australia. Other stations are situated on islands in the Atlantic and Pacific oceans, and there are two on ships, one in the mid-Atlantic and the other in the Indian Ocean. These stations are able to "track" the capsule in its path around the earth by radio, radar, and other means. The operators can continually report their observations to the control center by radio. As the capsule starts its descent to earth, the people in these stations can predict, within a few miles, where the astronaut will land. This simplifies the job of the recovery group.

THE RECOVERY GROUP

Mercury will not be a successful project until the astronaut is safely recovered after landing. The landing will be on water, somewhere in the Atlantic Ocean between Florida and the African coast. This is a large area in which to find a 10-foot capsule! How will it be done?

A large force is assigned to the job. A flotilla of ships from the United States Navy patrols different parts of the Atlantic Ocean. Long-range search aircraft fly over the Atlantic Ocean from Cape Canaveral, Puerto Rico, Bermuda, the Azores, and the African coast. The search planes and ships are equipped



The Mercury capsule splashes in the Atlantic Ocean after a test of the escape rocket system. The parachute separates after the landing and the capsule is recovered by a helicopter.

with radio, radar, sonar, and other devices for locating the capsule. The capsule itself has bright yellow water dyes, smoke flairs, depth charges, and a radio beacon with which the astronaut can indicate his position to the searching planes and ships.

High Frequency Point-to-Point Radio

Boresight

Tower

Command
Control and
Voice Transmitter

Telemetry and
Voice Receiver

500-Mile
Radar
(FPS-16)

700-Mile
Radar
(Verlort)

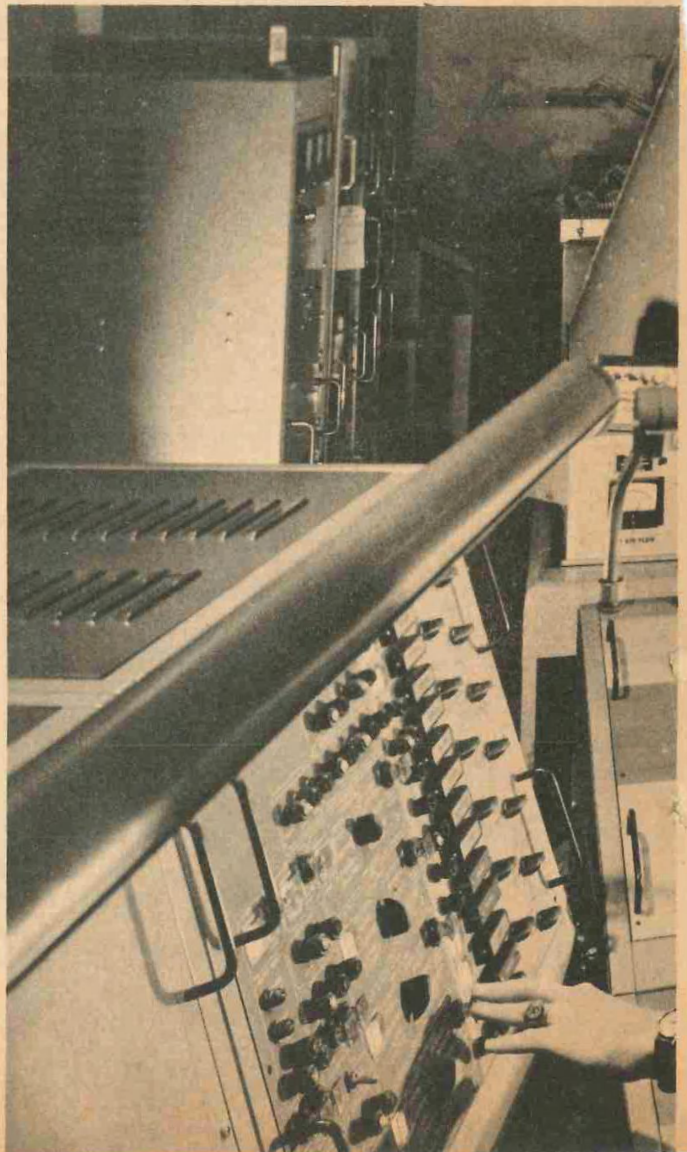
Telemetry and Voice
Receiver and
Acquisition Aid

Here you see what a typical Project Mercury tracking station looks like. At the tracking stations the technicians

and scientists will trace the progress of the Mercury capsule as it passes over their region.

THE ASTRONAUTS GO TO SCHOOL

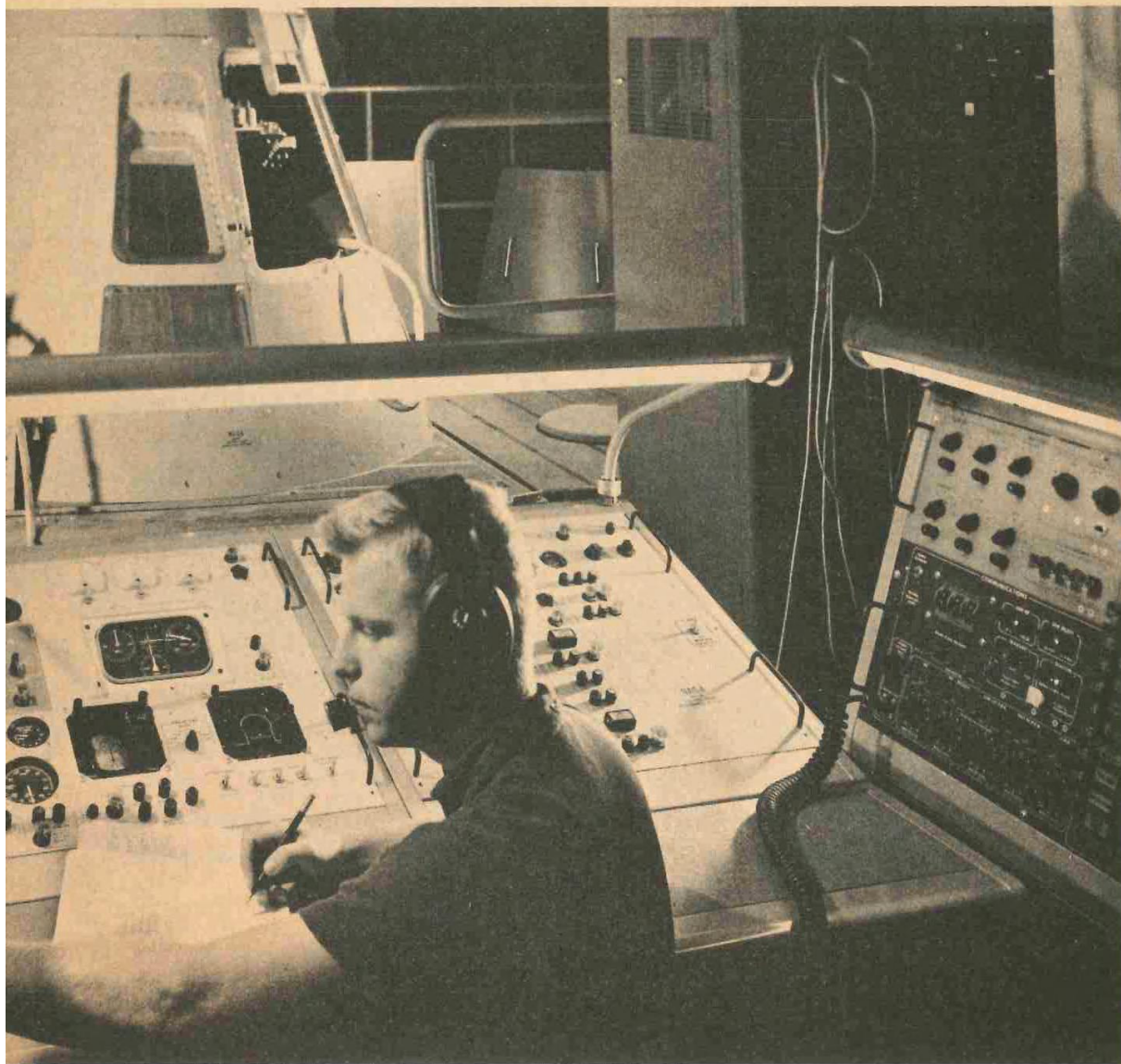
One of the Project Mercury training devices is a complete capsule (background) in which the astronauts "fly" space missions without leaving the ground. All of the conditions of space flight are duplicated by electronics. At an instrument panel, an engineer watches to make sure the astronaut is doing everything right. By pushing a button, he can also create trouble for the astronaut to correct.



How do you train an astronaut? What does he have to learn?
A great many things.

First, there is the schoolroom course. Here the astronauts are given detailed instruction in rocket power, guidance, space navigation, human life in space, astronomy, everything connected with space flight.

Next, they make visits to the factories where the equipment for Project Mercury is being built. They learn all there is to know about the capsule and its instruments, the rocket power system, the space suits they will wear, the communications network, in fact, all they need to know about the Mercury hardware.





Each astronaut must have a couch specially molded to his space-suited form. The couch, made of foam rubber, protects the astronaut against blast-off and re-entry shocks as he rides in the Mercury capsule.

The home station of the astronauts is at Langley Air Force Base, Virginia. Here NASA's Space Task Group built a number of special devices — called trainers — to familiarize the astronauts with the problems they would encounter in space. One of these trainers is a dummy capsule. It has the same instruments and controls as the real capsule. By electronic means, the trainer duplicates all the conditions of actual flight, even to the roar of the launching vehicle. In this trainer, the astronauts run through simulated space flights for hours at a time.

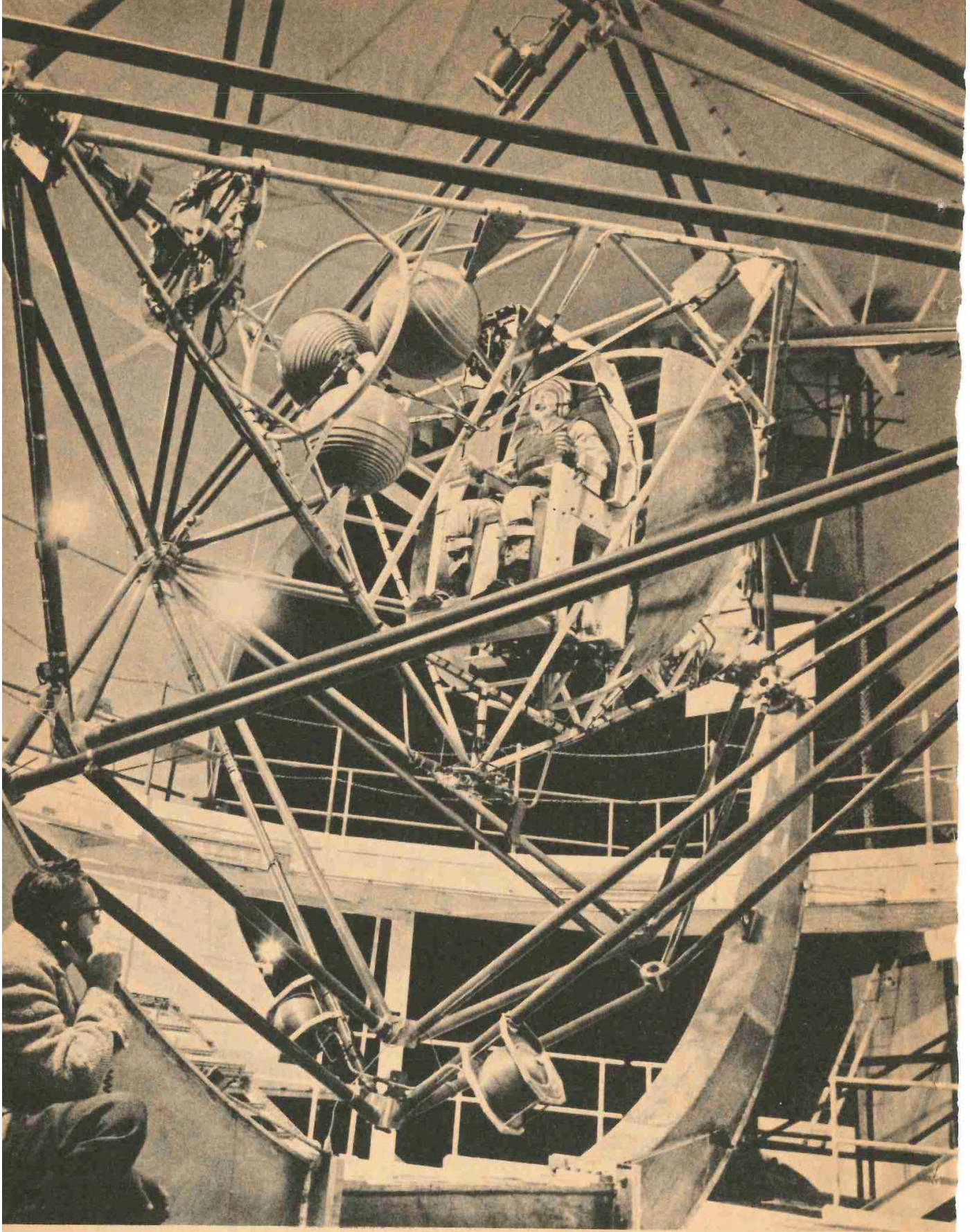
In another trainer, the space men learn how to handle the controls which change the position of the capsule. In still another, they learn how to navigate in space.

The pressures of space are a great problem. What if the capsule's pressurization system breaks down? The astronaut must then depend on his space suit. In a "pressure chamber," the astronauts spend a lot of time learning to live in these space suits.

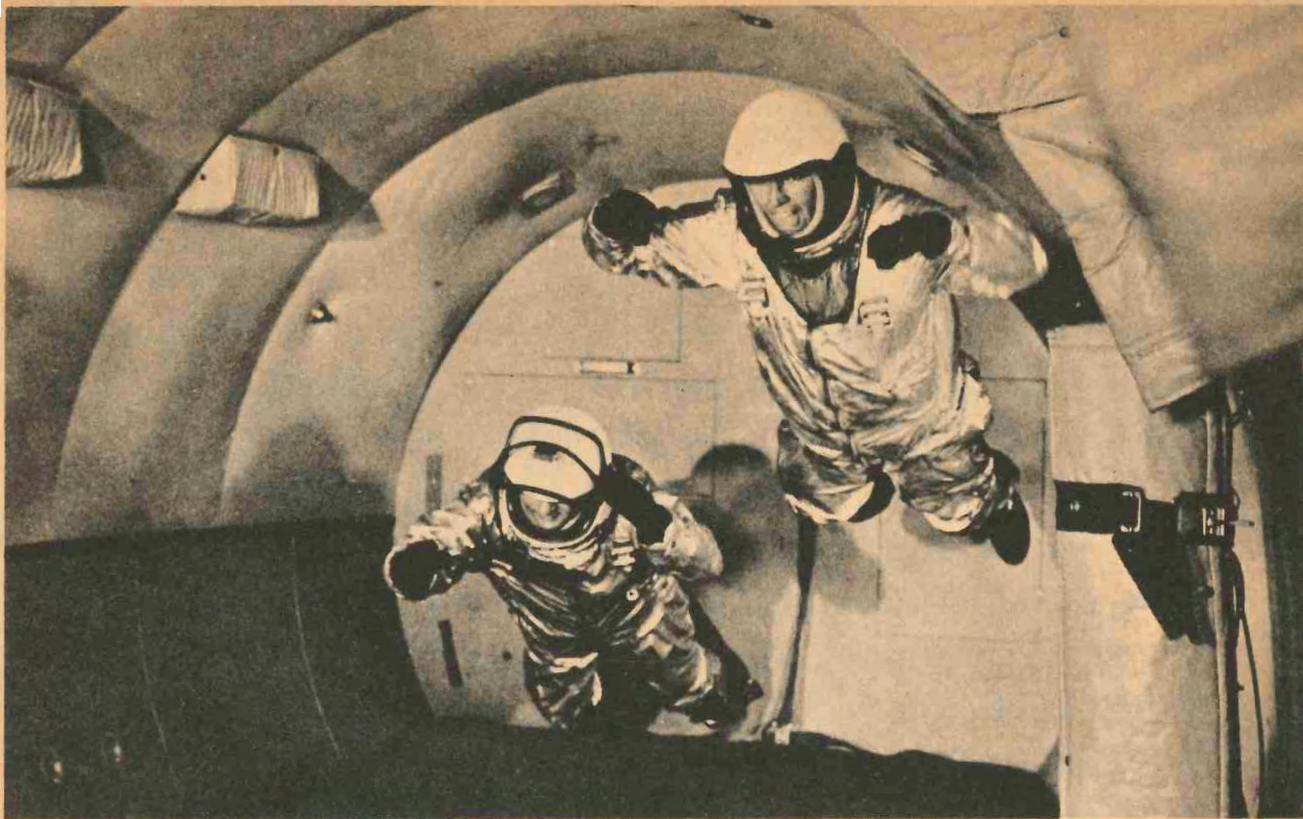
In another chamber, the conditions of re-entry — rapidly changing pressures and temperatures — are duplicated.

The astronauts study carefully the workings of the escape rocket — which they hope they will never have to use! They learn how to get out of the capsule and into a small life raft should the capsule spring a leak when it strikes the water.

One of the most interesting lessons the astronauts learn is how it feels to be weightless. We have weight on earth because of the earth's gravity. On a Mercury flight, the capsule will move through space at about 18,000 miles an hour. This great speed will develop a force that will balance



In this weird-looking training machine, the astronauts learn how to operate the controls which change the position of the capsule.



Astronauts Virgil Grissom (left) and Leroy Cooper float in a C-131 aircraft during a weightlessness run. The aircraft coasts over an arc to give everything inside the plane 13 seconds of weightlessness. The astronauts are wearing full pressure suits similar to the type they will wear on space trips.

the force of the earth's gravity, but this force will pull the capsule in the opposite direction. In other words, the earth's gravity will pull the capsule earthward, but another force created by the capsule's speed will pull it *away* from the earth. The result of this space tug of war is that the earth's gravity will be counterbalanced. Because of this, the capsule and everything in it will actually weigh nothing. You can get an idea of what weightlessness feels like in a roller coaster, at the instant the coaster dips over a sharp peak and starts down the other side.

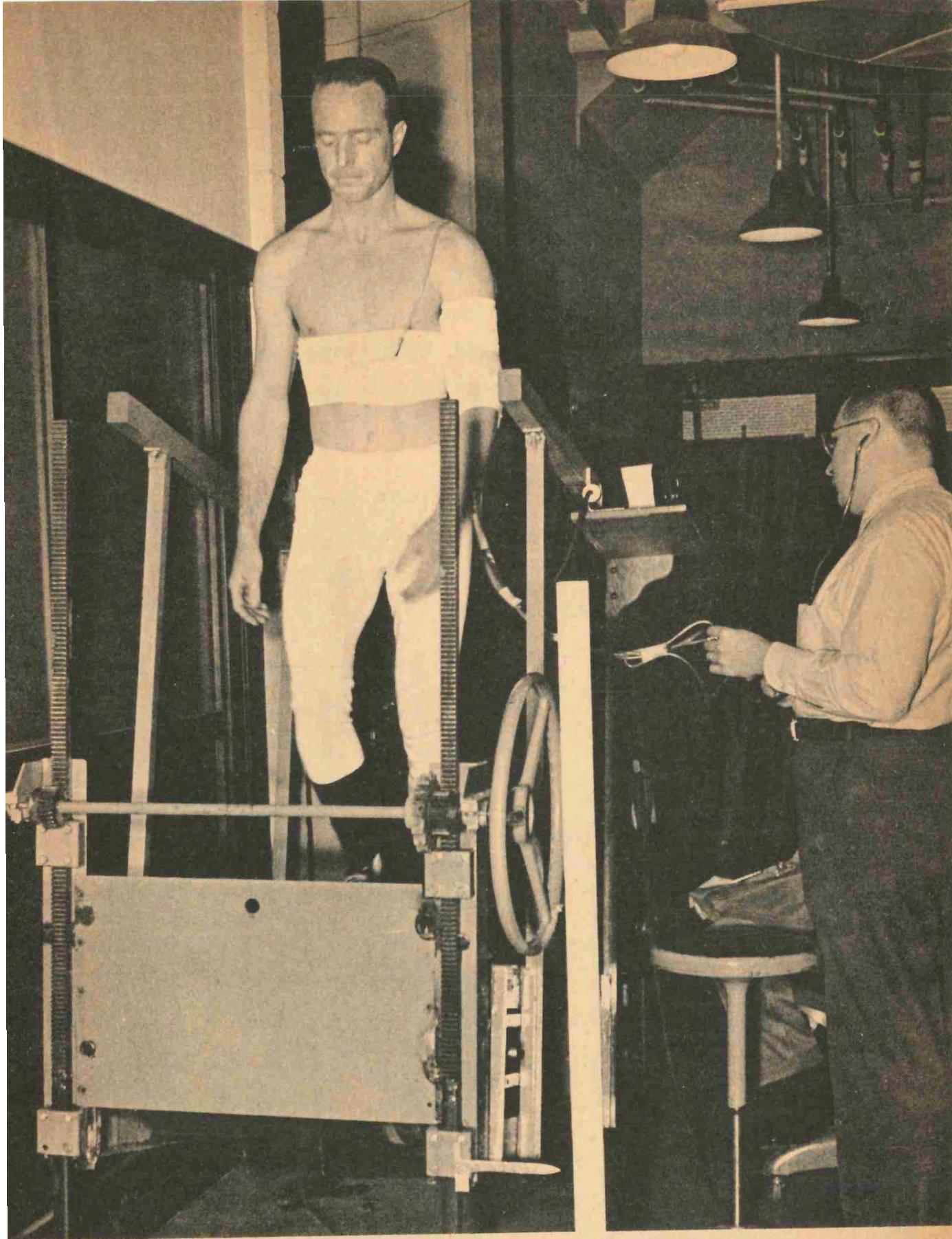
You can do the same thing in an airplane. You dive the plane rapidly to pick up speed. Then you climb sharply and "nose over" into another rapid dive. As you go over the top

of the arc, you become weightless for a very brief period. In a speedy jet, weightlessness can be maintained for about a minute. Each astronaut makes a long series of flights like this to acquaint himself with the "feel" of weightlessness.

Of course, in the jets the astronauts are strapped in the cockpit, so they do not float as a weightless body would. To get the floating sensation, they make other flights in the cabin of a transport airplane, where they actually float in air for short periods. The astronauts have not reported any ill effects during these tests. In airplanes they are weightless only for a minute or less. How will the human body react to very long periods of weightlessness? No one is sure. This is one of the many things scientists hope to learn from Project Mercury. On a Mercury orbital mission, the astronaut will be weightless for four hours.

The astronaut will not be floating around in the capsule during this period. He will be strapped down in his couch. His body, weightless, will strain upward against the straps, trying to float. He may, on one or two occasions, loosen the straps to test the floating sensation. Scientists want to learn whether this long period of weightlessness will make humans ill or mentally confused, because this knowledge will be important in future space flight.

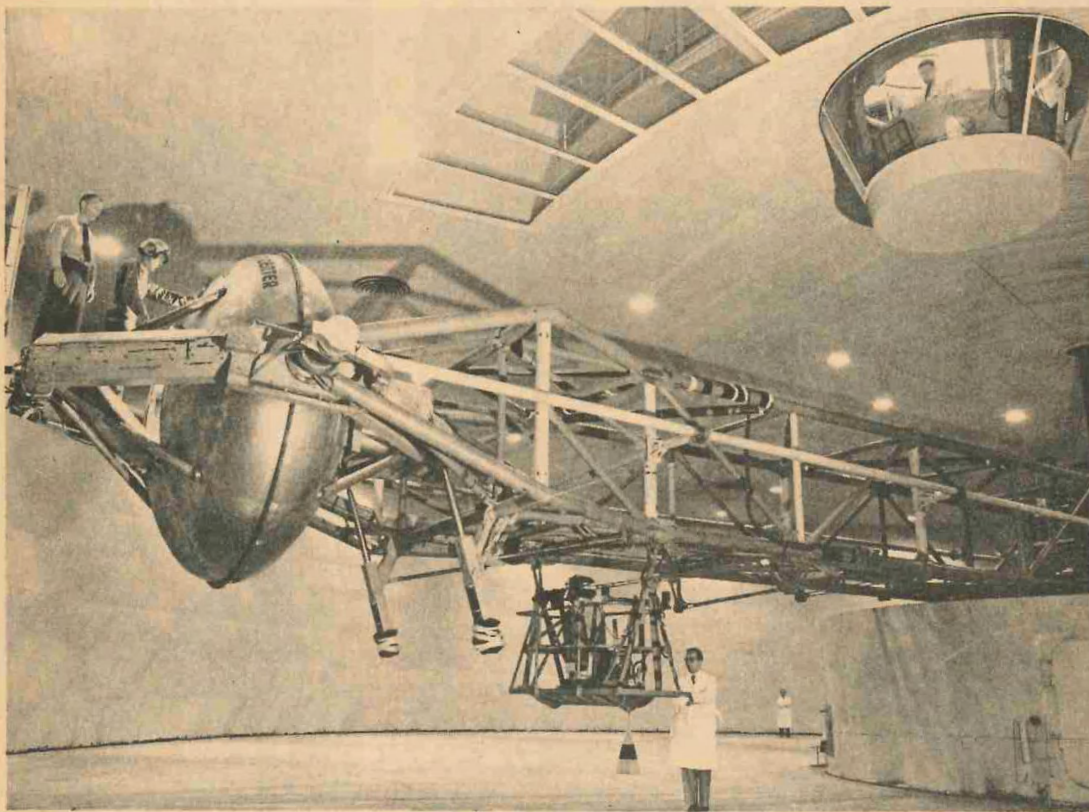
Another interesting part of the astronaut training program is riding in "centrifuge." A centrifuge is a high-speed merry-go-round. A capsule on the end of a long arm is rotated very rapidly. This rotation produces a force on the human body identical to the force produced by a rocket taking off and picking up speed rapidly. It is called an "acceleration force,"



Astronaut Malcolm Carpenter walks on a treadmill during a stress check. This is one way of checking the astronauts' physical fitness.

or a "G force." Its effect is something like the feeling you have when riding in a fast elevator. On a Mercury space flight, the astronaut will be subjected to forces of as much as nine G's. This means he will actually weigh nine times as much as he does on earth. Under this great pressure, it is difficult even to move a finger. This gives the astronaut an idea of how he will feel on take-off. The astronauts have sustained as much as sixteen G's in these tests without harmful effects.

Many of these tests the astronauts take over and over again. They will be training right up to the morning of the Big Day. On that day, they will be as ready for the historic flight as it is possible to make them.



A Mercury astronaut prepares to undergo the stresses of acceleration and re-entry in the centrifuge at the Naval Air Development Center.

BEFORE THE FLIGHT

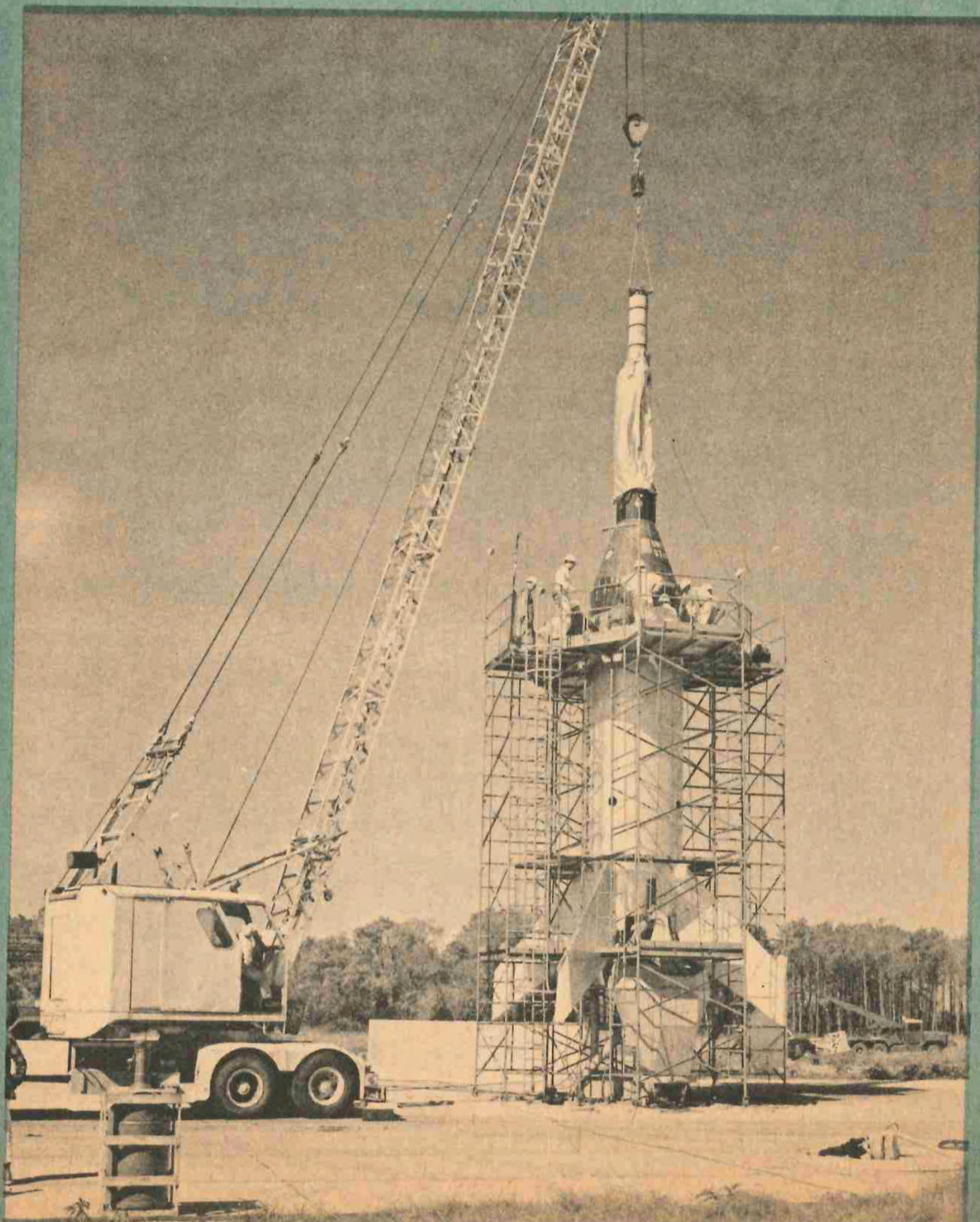
While the astronauts go through their training, the scientists and engineers of the National Aeronautics and Space Administration are busy, too. They are conducting a long series of tests on the equipment to be used in Project Mercury.

Of course, the Atlas-D is being thoroughly tested by the Air Force. It is a guided missile and it is constantly being tested.

The capsule, the most important single part of the Mercury system, came in for special tests. First, a number of dummy capsules were built and dropped by parachute from planes flying about a mile high. This tested the parachute itself and the capsule's ability to withstand the shock of impact on the water.

Then NASA built a special rocket called "Little Joe" to test the capsule, parachutes, and the escape rocket in actual flight. Little Joe is a small version of the big Atlas-D which will launch the Mercury capsule. A number of Little Joe test shots have been and are being made. The capsule, parachutes, and escape rocket have worked well so far. However, the Little Joe series revealed a few minor changes that could be made to make these Mercury parts work even better. These changes were ordered.

A "Little Joe" test vehicle (below) is readied for launch at the Wallops Station, Virginia, test base of the National Aeronautics and Space Administration. This shot was designed to test the Mercury capsule at high launching pressures. The capsule is mounted on top of the rocket at the upper platform, where the workmen are giving it a final check. On the opposite page, a Little Joe takes off on a test flight. Here the Little Joe is used to test the operation of the escape rocket mounted on top of the capsule. Much was learned as a result of these important tests.





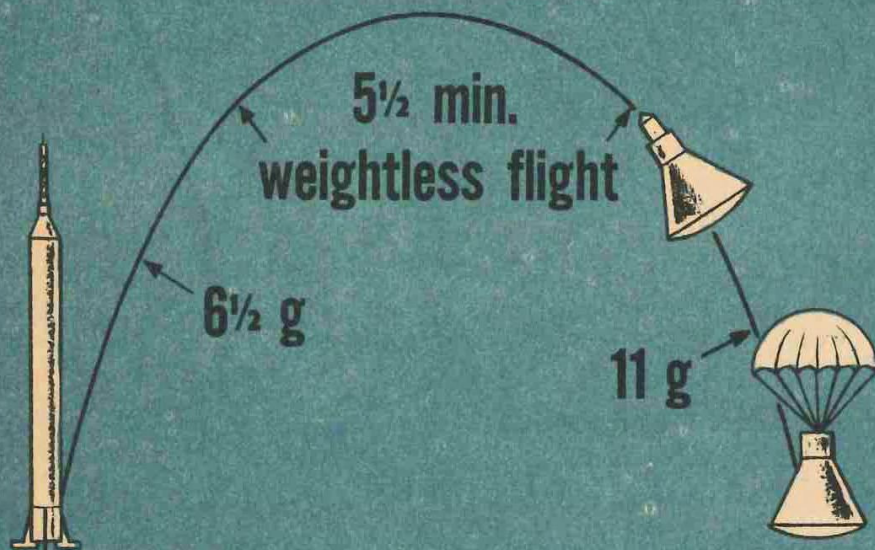
In the Little Joe tests, the speed of the capsule was only about 4,000 miles per hour. Now it was necessary to study the behavior of the capsule at very high speed and also to test the vital heat shield during re-entry. To do this, NASA used a larger rocket called "Big Joe." Big Joe is an Atlas launcher somewhat like the one to be used on the orbital missions. It can boost the capsule to speeds of more than 15,000 miles an hour and to altitudes of 100 miles. In the Big Joe tests, the heat shield successfully withstood re-entry temperatures. The capsule's high-speed performance was excellent.

Meanwhile, on the ground, all other parts of the Mercury system were undergoing tests. The small control rockets, which permit the astronaut to change the position of his capsule, were tested in wind tunnels. So were the retro rockets, the space brakes for re-entry. The capsule's pressure system, the instruments, the space suit, the communications equipment, every part of Project Mercury was given a very thorough test. Such tests will continue right up to the minute of the first Mercury launching. And before the first astronaut is sent into space, animal tests will be made with chimpanzees riding in the capsule.

The most important test of all is called the "manned sub-orbital flight." This test involves firing a man up to about 125 miles altitude and about 200 miles out into the Atlantic. In this test, the capsule does not go into orbit, but launching and recovery are practically the same as in the orbital flight. Animals have been put through similar tests.

For this mission, the capsule is boosted by a Redstone

Trajectory 125 mile altitude



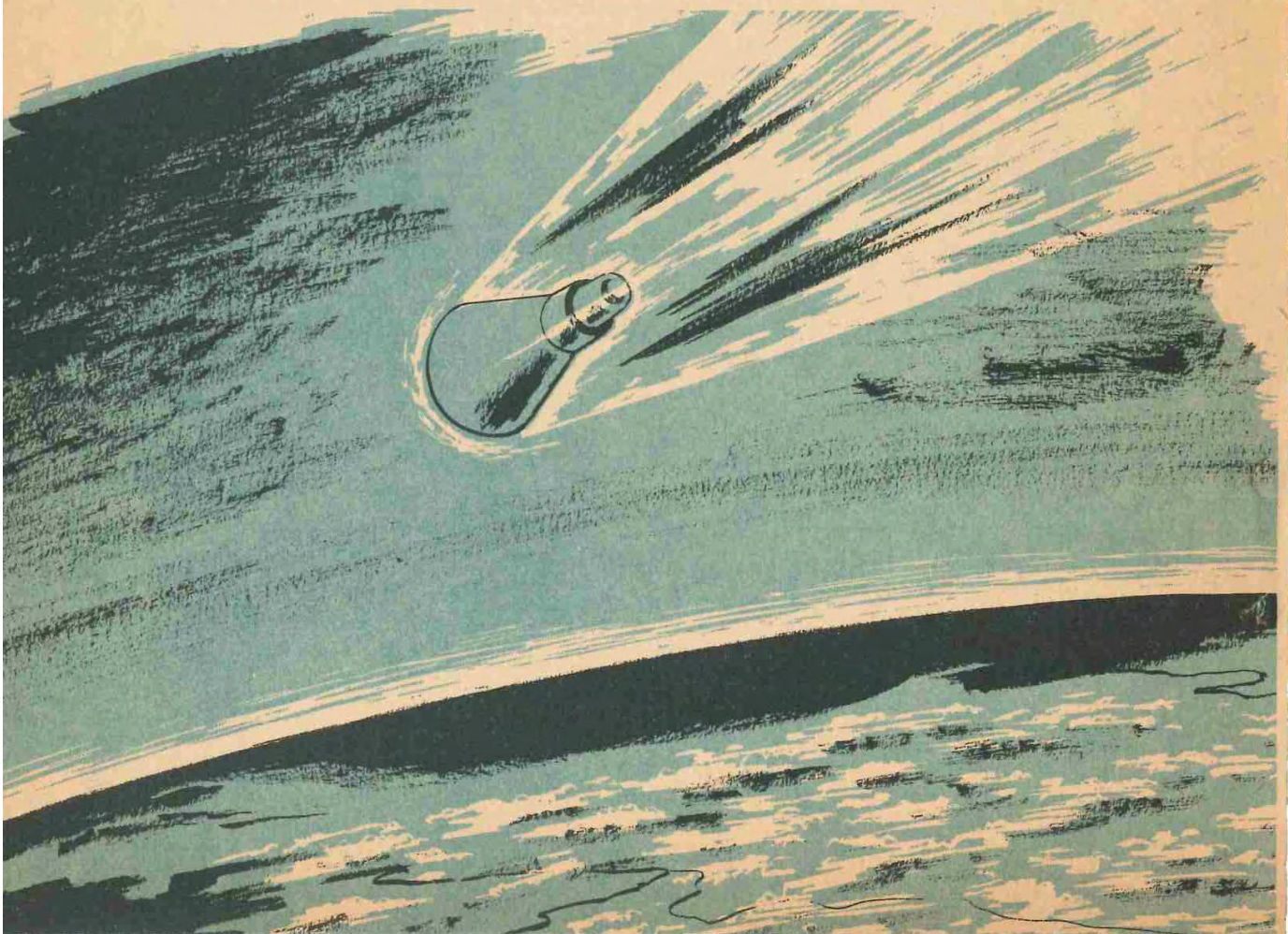
Cape
Canaveral

200 mile range
(16½ min.)

The manned suborbital flight is the most important Project Mercury test. In it an astronaut is blasted about 125 miles up and 200 miles out into the Atlantic Ocean by a Redstone rocket. Here you see the Redstone (right) and a chart (above) of the flight plan.



rocket. The Redstone is a military missile smaller and less powerful than Atlas-D. The suborbital flight takes about fifteen minutes. The astronaut is weightless for about five and one-half minutes. The capsule reaches a speed of about 4,000 miles an hour. For this reason, re-entry heating is not as severe as on the orbital flight. In all other respects the differences between orbital and suborbital flights are slight, so this type of test is actually a short-duration space flight.



FLIGHT AND RECOVERY

We left the astronaut just as he entered orbit. What happens next?

First, he changes the position of the capsule. Now the heat shield is the fore part of the capsule as it whips through space at 18,000 miles an hour. The astronaut is sitting upright.

Now he takes a look through his periscope. He views one of the greatest sights ever beheld by man. He is looking at our planet earth from a point in space, man's goal for centuries. It is like standing off a few feet and looking at a large globe such as you have in your school. It is a thrilling, dramatic sight. In one sweeping view the astronaut can take in most of the Atlantic coast of the United States.



In just a few minutes the capsule is far out over the Atlantic Ocean, headed east toward Africa. During its flight, the capsule will sail across Africa, over the Indian Ocean and on to Australia. At its terrific speed, it will take the capsule just ten minutes to cross the vast expanse of Australia. Then it will zoom across the Pacific Ocean, over the new state of Hawaii, and back to the United States. This circle will be repeated three times.

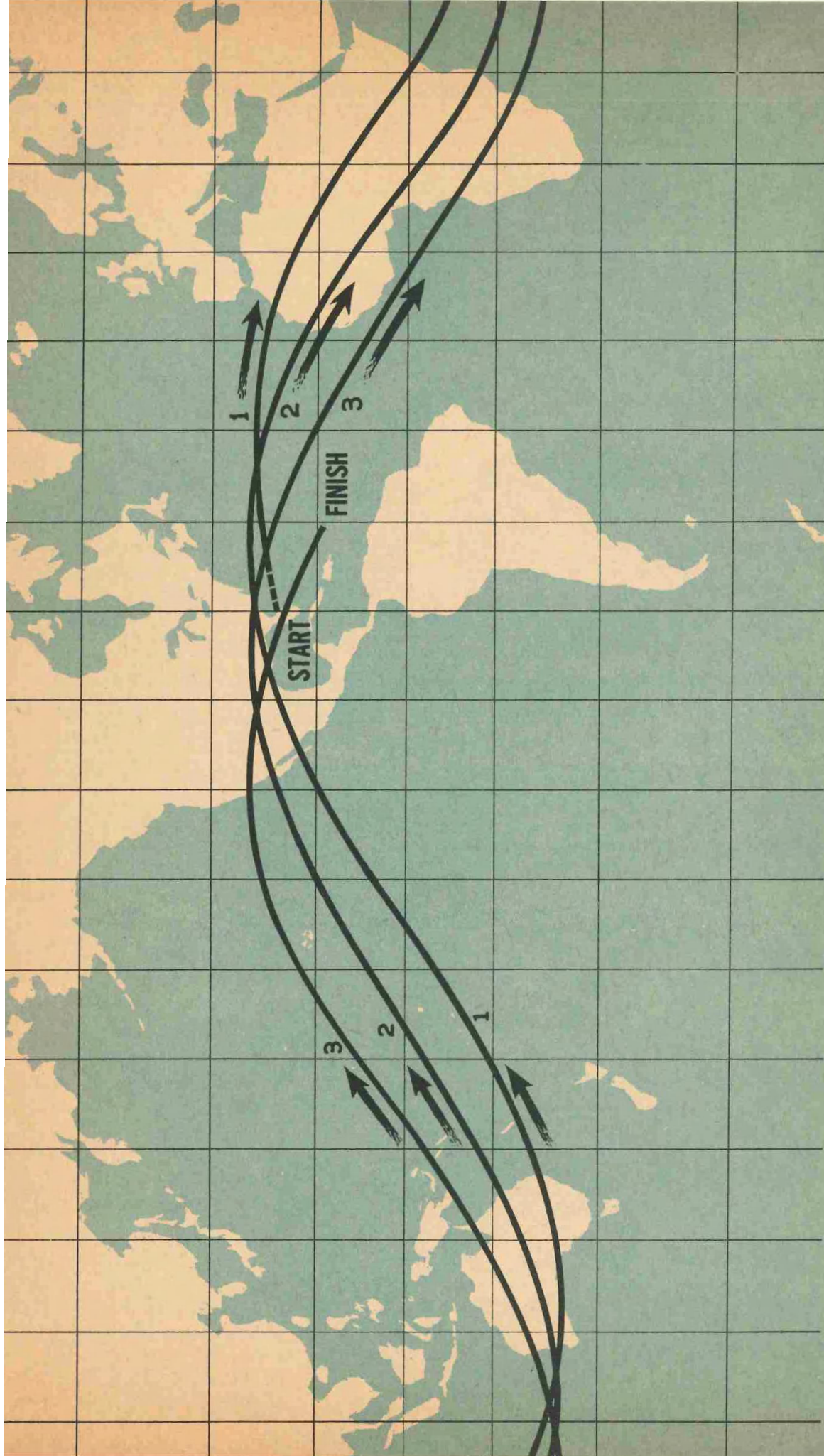
The army of scientists, engineers, technicians, and observers in the control center and the tracking stations are following the flight closely. The tension has not lessened. It is a great moment in history.

The astronaut is busy. He is talking to the ground stations. He describes his emotions, the feeling of utter isolation at being alone in space. He tells about his physical condition, how it feels to be weightless. He makes scientific observations. What does the sun look like, seen without the filtering layer of atmosphere through which man has always viewed it? What about the stars? What is the temperature, the pressure? He watches his instrument panel carefully for any indication of trouble.

It is X plus ninety. In just an hour and a half, he has circled the earth. Now he is back over Florida.

Below, the crews of the planes and ships of the recovery group are listening intently over the radio. Soon it will be time for them to go into action.

Africa, the Indian Ocean, Australia, Hawaii again. Then Southern California and, in minutes, Florida. In the control center, tension mounts. Project Mercury is approaching its



This map shows the paths through space of the Mercury capsule as it orbits the earth three times. The control

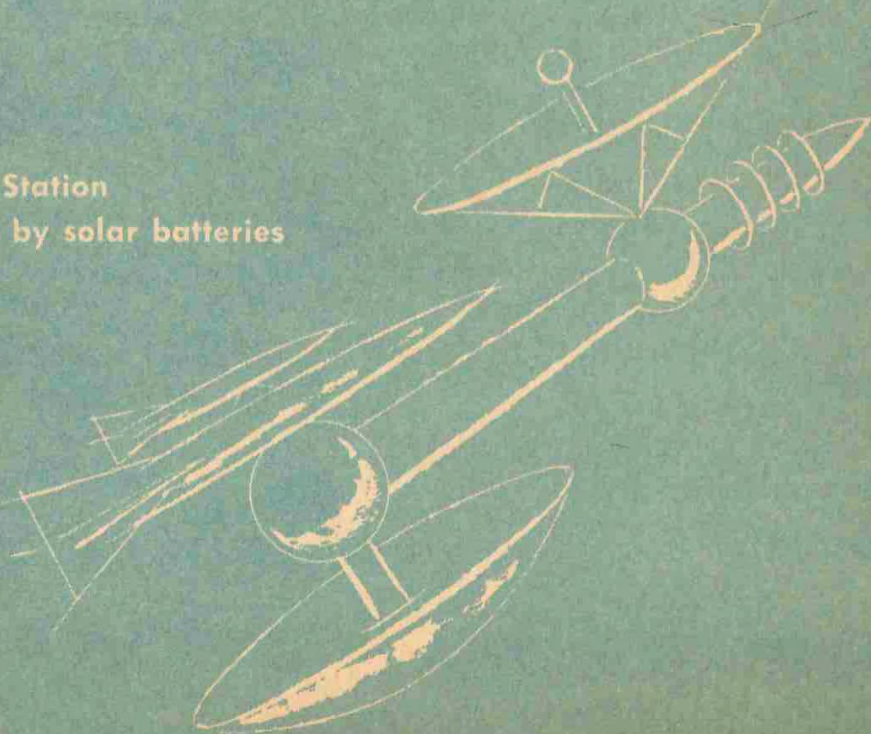
center at Cape Canaveral and tracking stations below these paths check on the capsule's progress.



Space Station

flights, man will only circle the moon and return to earth, but he will bring back invaluable knowledge about the earth's little satellite. Later — scientists say it will probably be after 1970 — man will land on the moon. Probably about the same time, perhaps a little earlier, we will orbit manned space platforms carrying men who will make scientific observations.

A Space Station
powered by solar batteries

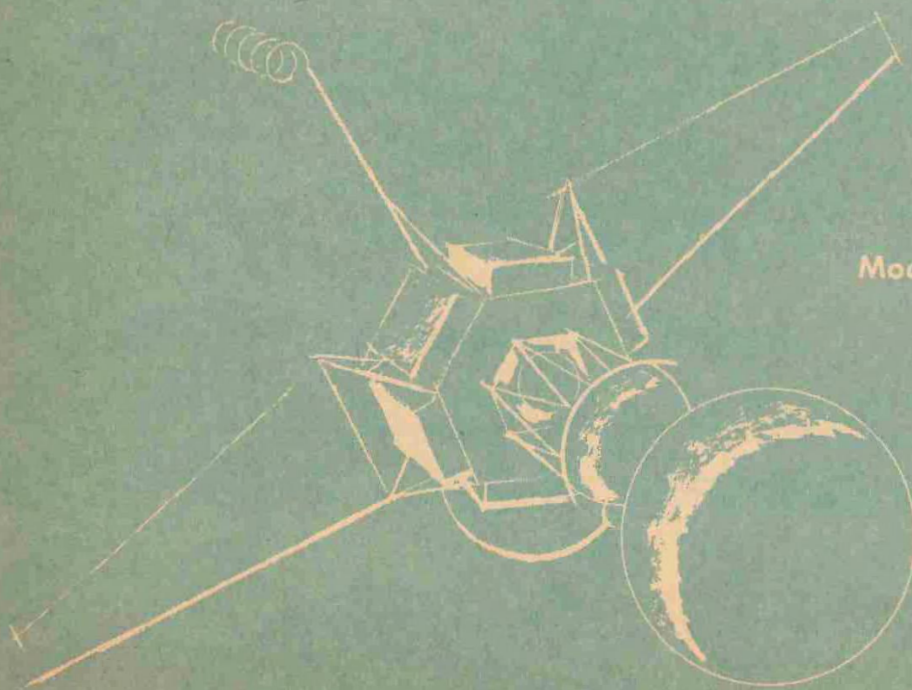


Space Ship



When man can venture to the planets, no one can yet say, but most experts feel it will come within the twentieth century. In the meantime, probably within the next few years, we will be sending unmanned space probes to Mars and Venus, our closest neighbors in the solar system. Once thought to be pure science fiction, these space trips are on the threshold of reality. Project Mercury is their pathfinder.

Moon Capsule



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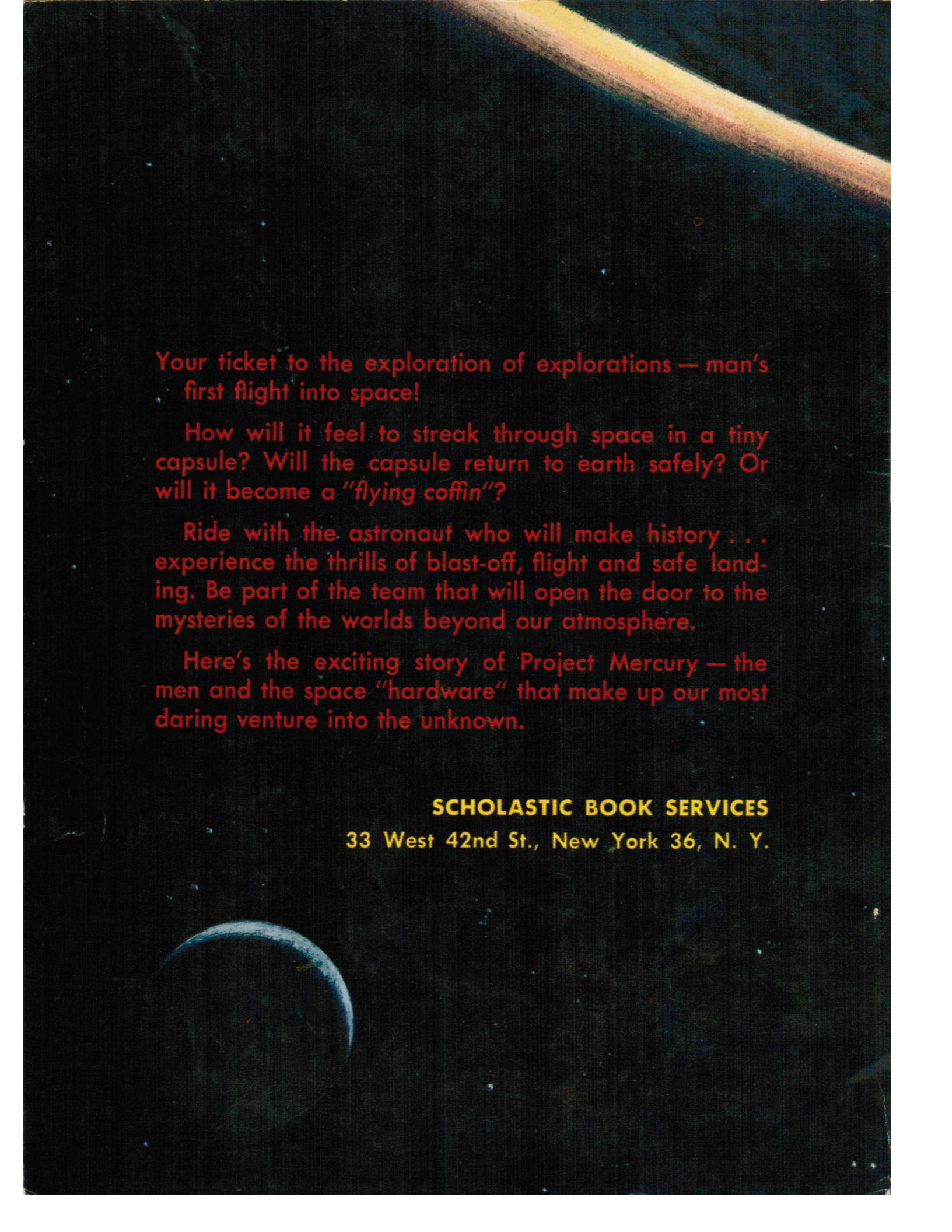
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